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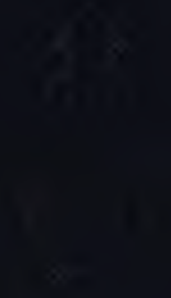

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ANATOMY OF THE INTERNAL AND EXTERNAL GENITALS
MENSTRUATION AND FECUNDATION
NORMAL PREGNANCY AND LABOR

BEING VOLUME ONE OF

A PRACTICAL TREATISE ON
OBSTETRICS

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BY
DR. A. CHARPENTIER,
ADJUNCT PROFESSOR AT THE FACULTY OF MEDICINE, PARIS.

TRANSLATED UNDER THE SUPERVISION OF, AND WITH NOTES AND ADDITIONS
BY
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157 AND 159 WILLIAM STREET
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AUTHOR'S PREFACE.

DURING the past twenty years, works on Obstetrics have been published in such number, both in France and abroad, that our classical treatises are no longer exact exponents of the modern science. Seeing that for two years I have acted as head of the Obstetrical Clinic, at the School of Medicine, and as adjunct to the Chairs of Obstetrics held by Professors Pajot and Depaul, I have necessarily kept abreast of the progress in this science, as well in the theory as in the practice, and my personal experience has been ample enough to allow me to judge of the value of the works which have appeared during this time. My knowledge of the German and English languages has enabled me to read in the original the works and the monographs published during the last twenty years, and thus to familiarize myself with the opinions of different authors, and to weigh the doctrines emanating from them. My aim, then, has been to write a treatise on Obstetrics which, while essentially practical, would give to the practitioner, to the student, and to the midwife, a sufficient, although condensed knowledge of modern researches, and thus to fill in the gaps which exist in our classical treatises.

My work, therefore, is both theoretical and practical—theoretical, because it is impossible to be a good practitioner without a broad knowledge of all the theoretical questions which concern our art; but above all *practical*, since the final aim of our profession is to save the lives of the two beings confided to our care, and we cannot insist enough on the means at our disposal for attaining this aim.

Without, therefore, entering into discussions entirely scientific, I have contented myself with condensing and analyzing any theory I have met with, and have given the practical reasons which have led me to adopt or to reject the opinions of the author from whom I have quoted.

A. CHARPENTIER.

PARIS, 1882.

EDITOR'S PREFACE.

Charpentier's work on Obstetrics is the most complete in any language, and is a faithful and unbiased mirror of the theories and of the practice of the most renowned obstetricians of the world. In the few years which have elapsed since its publication, there are certain topics wherein both practice and opinion have somewhat altered, and there are others which have become settled on a firmer basis than was then the case. It has been the aim of the editor to express these changes, and to add the requisite new matter, thus in every respect bringing the work up to date. He has also, here and there, criticized such methods as have seemed to him not completely in accord with the opinion of the authorities on this side of the Atlantic. These additions and notes have necessitated slight condensation in the text, and the omission of a number of statistical tables, but nothing of the kind has been done at the expense of the author's thought, or of the value of the work as one of reference. New illustrations have been substituted, and added, wherever it seemed appropriate. The section on Embryology, in Charpentier's treatise, has been omitted, and in its place has been substituted the admirable chapter which Professor Milnes Marshall contributed to Barnes's System of Obstetric Medicine and Surgery.

The notes and additions by the editor are enclosed within brackets—thus [ ].

EGBERT H. GRANDIN.

NEW YORK, *January*, 1887.

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PART I.

Anatomy of Organs pertaining to Generation.

CHAPTER I.

THE PELVIS.

THE pelvis is that part of the skeleton terminating the trunk; it articulates above with the vertebral column, rests below upon the femurs, and forms a canal wherein are performed the generative functions, and through which the fœtus travels to be delivered from the mother's womb. It is composed of four bones; the sacrum, the coccyx, and the ossa innominata.

PELVIC BONES.

The Sacrum.—This single and symmetrical bone forms the larger part of the posterior wall of the pelvis. It is a pyramid curved anteriorly, and flattened from before backwards, the base uppermost, the truncated apex below. Its base articulates with the spine, forming the promontory or sacro-vertebral angle. Below it articulates with the coccyx. It has two surfaces, two borders, a base and an apex.

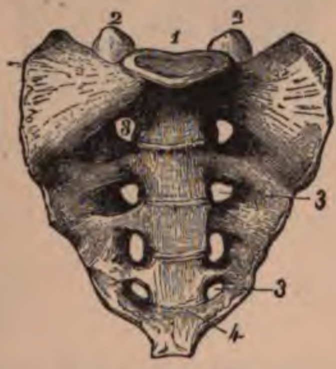


FIG. 1.—ANTERIOR SURFACE OF THE SACRUM.—1, The base. 2, Articular apophyses. 3, 4, Foramina.

Anterior Surface.—This, the pelvic face, is concave, forming the larger part of the posterior wall of the pelvic cavity. It shows several quadrilateral surfaces, separated by ridges, marking the union of the primitive portions of the bone. On either side of these lines are foramina—anterior-sacral foramina—communicating with the sacral canal, and allowing the exit of the anterior sacral nerves.

Above it is 4½ inches wide, and below—where it articulates with the coccyx—it measures .9 of an inch. It is 4½ inches high along a straight line, from the middle of the sacral promontory to the sacro-coccygeal articulation.

Posterior Surface.—The posterior surface is convex and uneven. Along the median line are eminences forming the sacral crest; and, placed one above the other, they represent the spinous processes of the vertebral column.

Above, this crest is limited by a triangular opening, the orifice of the sacral canal. Below, it bifurcates into two branches embracing the lower opening of the sacral canal, and terminating in two projections called the cornua of the sacrum.

The upper opening of the sacral canal has, on each side, two vertical projections, or articular processes, for articulation with the last lumbar vertebra. On each side of the sacral crest are two shallow grooves, in which are the posterior sacral foramina for exit of the posterior sacral nerves. Outside of these grooves are the rudimentary transverse processes.

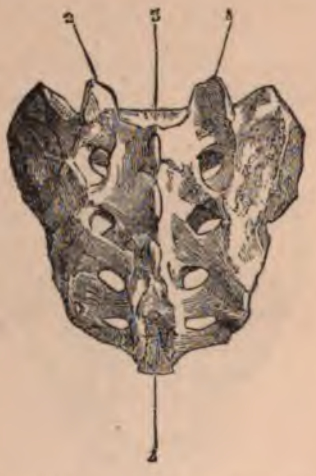


FIG. 2.—POSTERIOR SURFACE OF SACRUM.—1, 2, Spinous processes. 3, 4, Sacral canal.

Lateral Borders.—These consist of two parts; the upper is broad, and the lower is narrow. The upper one has an articular facet shaped like a human ear, for articulation with the os innominatum. It is slightly concave. The lower part is rough and serves for attachment of the greater and lesser sacro-sciatic ligaments.

All authors agree that the sides of the sacrum are cut obliquely:—(1) from before backwards and from without in;—and (2) from above downwards, and from without in. This double obliquity insures solidity of union between it and the coxal bone, preventing the descent of the sacrum, or any rocking motion between the two ilia.

Base.—This looks upwards and forwards. It has (1) an articular surface, very wide transversely, which joins the body of the last lumbar vertebra. (2.) Behind is the opening of the sacral canal, and the two articular projections for union with corresponding processes on the last vertebra. (3.) In front are two small concave surfaces forming grooves continuous with the first anterior sacral foramina. (4.) Further out are two prominences (rudiments of the transverse processes), surmounting a quadrilateral surface, convex from before backwards, concave from side to side, and inclining forwards. These are the alæ of the sacrum.

The anterior border is blunt, forms part of the internal iliac fossa, and contributes to the formation of the superior strait.

Apex.—This is truncated, and points downwards, presenting an elliptical facet, convex along its transverse diameter, which articulates with the base of the coccyx.

Sacral Canal.—The sacrum has a canal throughout its entire length. This is triangular and wide above, narrow and flat below, and forms the termination of the spinal canal. It ends in a groove lying between the sacrum and the coccyx. This groove is converted into a canal by ligaments. It contains the caudal portion of the spinal marrow.

Coccyx.

A single and symmetrical bone, situated below the sacrum, of which it seems the prolongation. The coccyx is shaped like a small triangular pyramid, slightly concave. It presents an anterior and a posterior face, two lateral edges, a base and an apex.

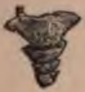


FIG. 3.—COCCYX, ANTERIOR SURFACE.

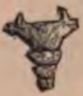


FIG. 4.—COCCYX, POSTERIOR SURFACE.

Anterior Face.—This is slightly concave, and recalls that of the sacrum, by the presence of projecting lines separating quadrangular spaces, which diminish from the base to the apex of the bone.

Posterior Face.—This is convex, rough, and is only separated from the skin of the coccygeal region by ligamentous fibres.

Edges.—The edges are rough, and give attachment to the ischio-coccygeal muscles, and to the sacro-sciatic ligaments.

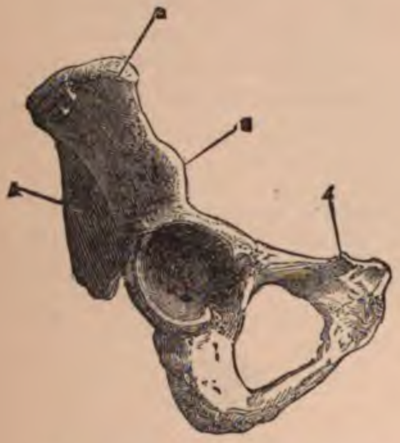
Base.—The base points upward, and presents an elliptical concave facet which articulates with the apex of the sacrum. Behind this facet are two projections which form the cornua of the coccyx.

Apex.—The sacrum and coccyx, placed below the vertebral column, the terminal prolongation of which they appear to be, are, in infancy, formed of separate pieces, which resemble the vertebræ. The pieces unite at about the 8th—10th year, and become firmly welded between the 15th —18th.

The Coxal-Bone or Os Innominatum.

The iliac bone, os innominatum, coxal-bone, or haunch bone, is a double, non-symmetrical bone which forms the front and side walls of the pelvis.

Formed by the union of three bones, the ilium, the pubis, and the ischium, which do not become welded together till 15 or 16 years of age, it presents an extremely irregular aspect. It has a quadrilateral shape, in which two parts can be distinguished: an upper part, flattened from within outwards; a lower part, flattened from in front backwards.—Two faces and one circumference can be distinguished.



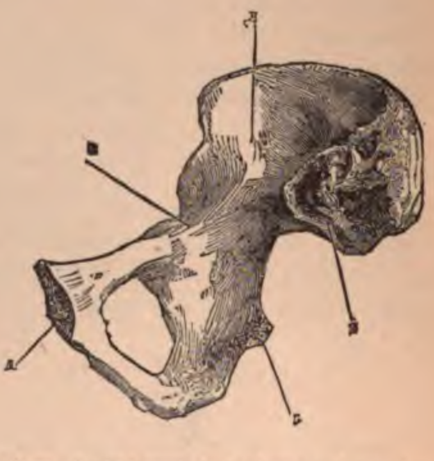


FIG. 5.—OS INNOMINATUM.—1, External iliac fossa. 2, Iliac crest and anterior and superior spine. 3, Anterior and inferior spine. 4, Tuberosity of the pubis.

FIG. 6.—OS INNOMINATUM.—1, Internal iliac fossa. 2, Auricular surface. 3, Linea innominata. 4, Articular surface of pubis. 5, Sciatic spine.

External Face.—The external or femoral face has, in its centre, the cotyloid cavity, which is deep, hemispherical, and, for the larger part, smooth. Its edge is thin, sharp and sinuous, with two depressions and a notch. The two depressions correspond to the tendons of the pyramidalis and psoas and iliacus muscles. Through the notch, which by a ligament is formed into a foramen, pass the vessels.

The cotyloid cavity receives the head of the femur. The ligamentum teres is attached to its base. It faces downward, outward and a little forward.

Above the cotyloid cavity is a large surface, concave on the back, convex in front. This is the external iliac fossa, which is crossed by two slightly projecting crests, to which the gluteal muscles are attached.

The external face shows the obturator or sub-pubic foramen, below the cotyloid cavity. This is nearly triangular in shape, presenting, above and outside, a groove through which pass the sub-pubic nerves and vessels. This is the obturator groove. The foramen is closed by a fibrous membrane—the obturator membrane. It is limited above by a convex prismatic surface, the horizontal ramus of the pubes; on the inner side and above by a quadrilateral surface, the body of the pubes; on the inner side and below by another quadrilateral surface, which is long, and runs from above downward, and from the inner side outward. This is the ramus of the ischium. Finally, the foramen is closed below and externally by a larger mass, the tuberosity of the ischium, which ends the body of the ischium. Between the cotyloid cavity and the body of the ischium is a groove for the passage of the tendon of the external obturator.

Internal Face.—This presents near its centre a curved line, the linea innominata dividing the face into two parts, the superior and the inferior, and forming part of the superior strait. The line is limited in front by the ilio-pectinal eminence, behind by the sacro-iliac symphysis. That portion of the internal face of the iliac bone which is above the linea innominata has two parts. The first, oblique and concave, facing downwards, is smooth, and is the internal iliac fossa. The other is itself divided into two parts, one the articular part, which articulates with the corresponding surface of the sacrum, the other, uneven and rough, to which strong ligaments are attached. Upon this rough part there is a projecting point which is received into a corresponding depression of the sacrum.

Below the linea innominata, are found: 1st, The posterior face and the horizontal ramus of the pubes; 2d, the obturator foramen and its groove; 3rd, the posterior face of the ascending ramus of the ischium, of the body, and of the tuberosity of the ischium; 4th, a large quadrilateral surface forming the floor of the cotyloid cavity.

Circumference.—Very irregular: it may be divided into four parts—superior, inferior, anterior and posterior.

Superior Edge.—The superior edge, or iliac crest, is limited in front by the anterior and superior iliac spine, behind by the posterior and superior iliac spine. It is shaped like an italic *S*, presenting two lips and an interstice to which are attached the oblique, and transversalis muscles of the abdomen.

Inferior Edge.—Above, this is formed vertically by an articular facet, which unites with a similar facet on the opposite side, to form the pubic symphysis. Laterally, it is formed by the edge of the ascending ramus of the ischium, and below, by the tuberosity of the ischium. All these parts together form the pubic arch.

The anterior or inguinal edge is concave. Above and on the outside are the anterior and superior iliac spines; below this a notch, then the anterior and inferior iliac spine, a groove for the tendons of the psoas and iliacus muscles, a round eminence, the ileo-pectinal, the superior face of the horizontal ramus of the pubes, the spine and angle of the pubes, and the point of meeting of the superior and inferior edges.

Posterior Edge.—This is concave from below downward. We find: first, the postero-superior iliac spine; below this a shallow notch, the postero-inferior iliac spine; below this a large notch, which is converted into a canal when the pelvis is complete in its soft parts; then the sciatic spine, the groove for the tendon of the internal obturator muscle, and finally the tuberosity of the ischium.

Articulations of the Pelvis.—The bones which constitute the pelvis are united by means of articulations to which the name of symphyses is given. They are four in number:

1st. The pubic symphysis.
2d. The two sacro-iliac synchondroses.
3d. The sacro-coccygeal symphysis.
4th. The sacro-vertebral symphysis, or the articulation of the sacrum with the vertebral column.

Symphysis Pubis.

This is a true amphiarthrosis or symphysis, and is composed of two articular surfaces, an interosseous fibro-cartilage, and four peripheral ligaments. (Fig. 7.)

Articular Surfaces.—Oval and rough, they present a posterior ellipsoid, the edge of which projects slightly backward, and an anterior part running obliquely from in front backwards, and from without inwards.

Between these two articular surfaces, and covering them, is an interosseous fibro-cartilage. This is analogous to the inter-vertebral discs, and like them is formed of two parts, the one, outer and unyielding, the other central and soft. It is thicker in front and from above downwards, forming behind a projection which extends beyond the bones. The soft part is so close to the posterior part that it seems to reach the limit of the bone. It has a cavity which has long been believed to be covered with synovial membrane.

Peripheral Ligaments.—There are four of these:—

1st. An anterior ligament, formed by fibres which, in consequence of the spines of the pubes, cross in front of the symphysis throughout its whole height, and adhere strongly to the interosseous fibro-cartilage.

2d. A posterior ligament, which seems to be nothing but a prolongation of the periosteum of the posterior face of the pubes.

3d. A superior ligament, which fills the upper triangular space.

4th. An inferior, the sub-pubic ligament, triangular in shape, thicker than the former ones, filling the lower triangular space, and inserted on the inter-pubic cartilage, laterally on the descending rami of the pubes. It has below a cavity which forms the top of the pubic arch.

The height of the symphysis varies from 1.5 to 1.9 inches. If in some women it seems higher, this is because it has a special inclination to the pelvis.

The Sacro-Iliac Synchondroses.

Considered by Boyer as a synarthrosis, by Blandin as a diarthrosis, they are to-day ranked by most authors as among the amphiarthroses.

According to Sappey they do not belong to either of these classes. Intermediate between movable and semi-movable articulations, they unite them, he says, thus forming an unbroken series.

Articular Surfaces.—These are formed by the articular facets of the os innominatum and sacrum. They lie obliquely from the base toward the apex of that bone, and from its anterior towards its posterior surface. Slightly sinuous, they are covered by a cartilage, thicker throughout on the sacrum than on the iliac bone. That which covers the iliac is a fibro-cartilage, that of the sacrum is both a true cartilage and a fibro-cartilage.

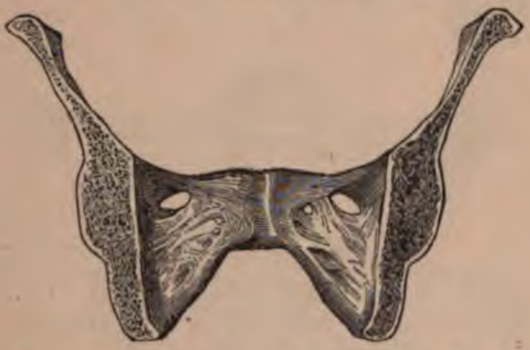


FIG. 7.—TRANSVERSE SECTION, ANTERIOR HALF OF PELVIS.—Symphysis pubis.

The ligaments are five in number: two anterior, divided into superior and inferior; two posterior, divided in the same way. The fifth is an interosseous ligament. Now to these five must be added a sixth, the ilio-lumbar ligament, which may be considered an appendage of the articulation.

This ilio-lumbar ligament, extends from the transverse process of the last lumbar vertebra to the corresponding part of the iliac crest. It is thick and round within, becoming flattened and more slender without. It is strong and resisting, uniting the lumbar vertebræ and the sacrum to the iliac bones, and completes above and behind the walls of the greater pelvis.

The antero-superior ligament is formed by the periosteum of the lateral parts of the base of the sacrum, and crosses the articular line while passing towards the internal iliac fossa.

The antero-inferior ligament is formed by the periosteum of the first two anterior sacral foramina, and, like the superior ligament, becomes one with that of the iliac bones.

The postero-superior ligament is composed of fibres which pass from the posterior part of the iliac crest, and from the subjacent roughened surface, to the tubercles situated on the outside of the first two posterior sacral foramina, and to the space between them, blending with the interosseous ligament.

The postero-inferior ligament is very thick, and may be divided into two layers: 1st, a superficial one, which is inserted above, on the posterior and superior iliac spine, and below, on the tubercle situated on the outside of the third posterior sacral foramen. This is the sacro-spinal ligament of Bichat, and the posterior sacro-vertical of Cruveilhier. It blends at its internal edge with the aponeurosis which covers the spinal muscles, and, at its external edge, with the great sacro-sciatic ligament; 2d, a deep layer arising from the whole of the space between the tubercles situated outside of the second and third posterior sacral foramina. It is attached to the two posterior iliac spines and the notch between them.

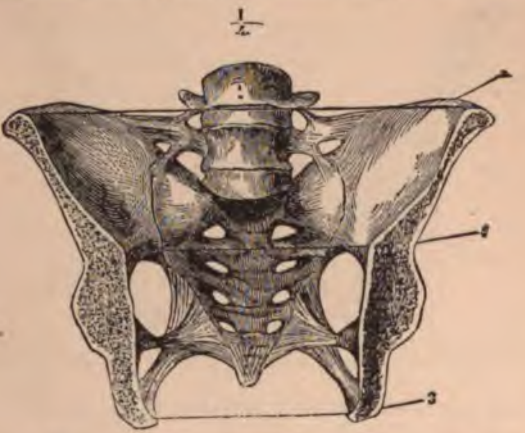
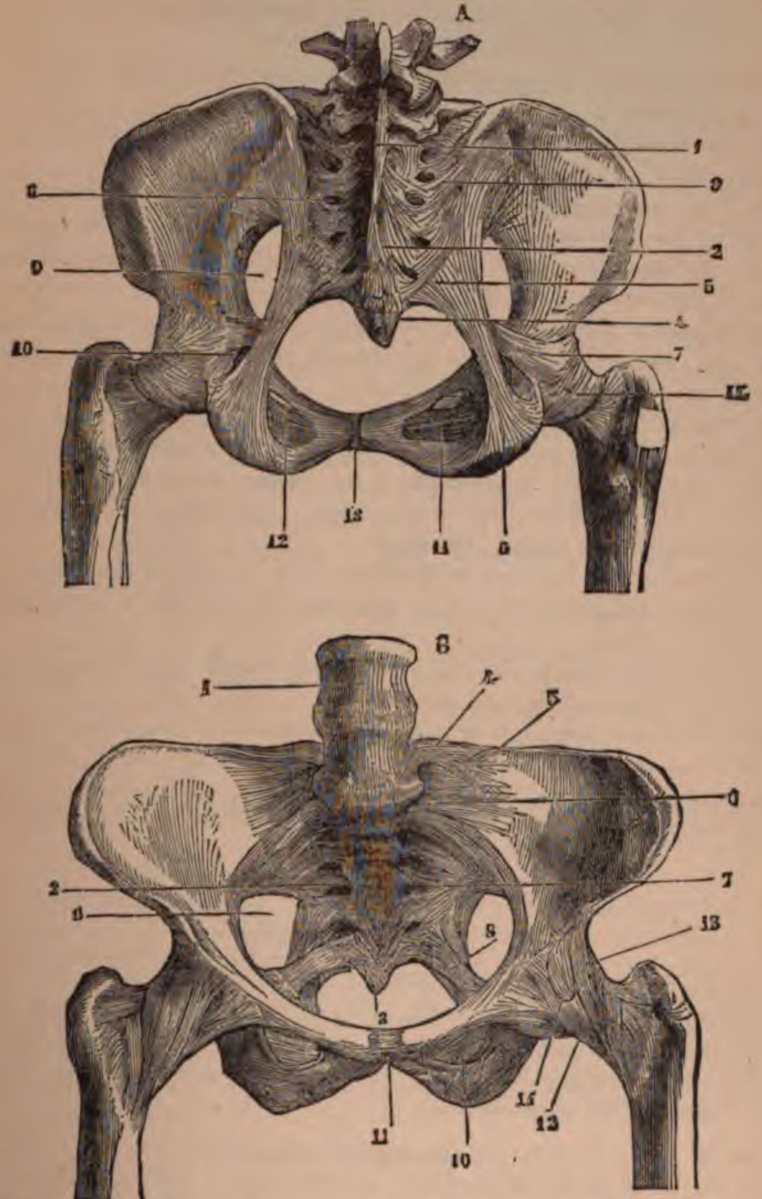


FIG. 8.—TRANSVERSE SECTION OF POSTERIOR PORTION OF PELVIS. SACRO-ILIAC SYMPHYSIS; SACRO-SCIATIC LIGAMENTS.—1, Transverse diameter of pelvis. 2, Transverse diameter of superior strait. 3, Transverse diameter of inferior strait.

The interosseous ligament, the strongest of all, occupies a deep cavity immediately behind the two articular facets. It is attached to the iliac tuberosity, and to two facets which are on the external apex of the first sacral foramen.

The Synovial Membrane.—The sacro-iliac articulation has a synovial membrane which covers the internal face of the ligaments to the level of the articular line. Its size does not exceed that of the line of articulation.



FIGS. 9 and 10.—LIGAMENTS OF THE PELVIS.—A. Posterior face. 1, Sacral crest. 2, Posterior sacro-coccygeal ligaments. 3, Posterior sacro-iliac ligament. 4, Posterior coccygeal ligament. 5. 6, Great sacro-sciatic ligament. 7, Lesser sacro-sciatic ligament. 8, Posterior sacral canals. 9, Greater sciatic notch. 10, Lesser sciatic notch. 11, Obturator membrane. 12, Obturator groove. 13, Pubic symphysis. 14, Posterior part of the coxo-femoral capsule.

B. Anterior face.—1, Lumbar vertebra. 2, Anterior face of sacrum, 3, Coccyx. 4, 5, Ilio-lumbar ligaments. 6, Superior sacro-iliac ligament. 7, Anterior sacro-iliac ligament. 8, Lesser sacro-sciatic ligament. 9, Greater sciatic notch. 10, Obturator membrane. 11, Pubic symphysis. 12, Capsule of the coxo-femoral articulation. 13, Berlin's ligament. 14, Serous sac of psoas (*Beaunis* and *Bouchard*, "Descriptive Anatomy.")

Movements.—The sacro-iliac articulation is not absolutely immovable, having a little sliding motion in several directions.

This arrangement of ligaments is strengthened by the sacro-sciatic and obturator ligaments.

The Sacro-Sciatic Ligaments.—There are two on each side, the large and the small.

The great sciatic ligament is attached by its base to the posterior extremity of the superior semi-circular line of the iliac bone, to the external edge of the superficial layer of the posterior and inferior sacro-iliac ligament, to the lateral parts of the sacrum, and to the whole of the corresponding edge of the coccyx. It becomes narrow in its middle, and larger at its apex, which is attached to the inferior part of the ischium, and to the external lip of the ascending branch.

By its posterior face it gives attachment to the gluteus maximus muscle. By its anterior face it is united to the lesser sciatic ligament. Its superior edge joins the great sciatic notch, closing above the greater sciatic canal, and below the lesser sciatic canal. Its inferior edge forms the lateral and posterior parts of the strait.

The lesser sciatic ligament is attached by its base to the lateral and inferior parts of the sacrum, and to the edges of the coccyx, by its apex, to the sciatic spine.

The two sciatic ligaments divide the sciatic notch into two canals, the greater and lesser sciatic foramina.

The obturator ligament, or obturator membrane, is a fibrous lamina which closes the sub-pubic canal, and is attached to the border of the obturator canal in such a manner as to leave free, and to convert into a canal, the groove through which the obturator nerves and vessels pass.

THE SACRO-ILIAC SYNCHONDROSES.

The Sacro-coccygeal Symphysis.

It is formed by the articular facet of the apex of the sacrum, by that which is at the base of the coccyx, by an interosseous fibro-cartilage, and by some ligaments which are named the anterior posterior and lateral sacro-coccygeal ligaments. These are fibres which stretch over the whole of the coccyx from top to bottom.

The Sacro-vertebral Articulation.

It consists of one amphiarthrosis, and two arthrodiæ. The amphiarthrosis is formed by the two articular surfaces of the inferior face of the lumbar vertebra, and of the base of the sacrum. The surfaces are united by a disc similar to the inter-vertebral discs.

The two arthrodiæ are formed by two small vertical facets on the sides of the superior opening of the sacral canal, and by two similar facets situated on the inferior face of the last lumbar vertebra, and which fit together.

They are united by ligamentous fibres, belonging to the common anterior and posterior vertebral ligament, to an inter-spinal ligament, and finally to a fascia which Bichat has called the sacro-vertebral fascia. It proceeds from the anterior and inferior part of the transverse process of the last lumbar vertebra, and is attached to the superior part of the sacrum.

THE PELVIS IN GENERAL.

Considered as a whole, the pelvis, formed by the union of the sacrum, the coccyx and the ossa innominata, and of the union of the sacrum with the vertebral column, has the shape of a bony canal, larger above than below, slightly flattened from in front, backwards.

Exterior Surface.—On the external surface of the bones which form the pelvis are found the parts already described. These have no importance from the obstetrician's point of view.

Internal Surface.—It is not so with the internal surface. This deserves, and calls for, our whole attention.

Smooth and regular, it is divided into two parts; one, the superior, large and wide, the greater pelvis; the other the inferior, narrower, the lesser pelvis. The larger pelvis is separated from the lesser by the superior strait, the lesser pelvis terminates in the inferior strait.

The Greater Pelvis.

It is formed by all that part of the internal surface comprised between the iliac crests, above, and the point where it narrows below, *i.e.*, by the line which forms the superior strait (Fig. 11).

In front we find a large notch; on the sides the iliac-fossæ, behind a protuberance formed by the sacro-vertebral angle, or promontory, and the body of the last lumbar vertebra. On the sides of this promontory is a deep groove, formed on the inside by the body of the same vertebra, the anterior face of the transverse process of that vertebra, and the ilio-lumbar ligament, on the outside, by the posterior surface of the internal iliac-fossa, and below by the quadrilateral surface which forms the wing of the sacrum.

The superior edge or circumference of the greater pelvis, which is broken at the level of the notch of the greater pelvis, is formed, posteriorly, by the superior face of the last lumbar vertebra, the transverse process of that vertebra, the ilio-lumbar ligament and the anterior four-fifths of the iliac crest.

In the living subject the notch is closed by the abdominal walls, which are attached to the iliac crests, and to the anterior edge of the ossa innominata.

Size.—From one anterior and superior iliac spine to the other the greater pelvis measures on the average from nine to ten inches.

From one iliac crest to the other, at the widest point, about 10¼ inches.

A line from the middle of the iliac crest to the middle of the linea innominata measures about 3.2 inches.

The Lesser Pelvis.

This is that portion of the pelvic canal which is situated below the greater pelvis. It is shaped like a canal slightly narrowed at its two ends.

It is composed of:—

The middle part or cavity.
The superior opening of that cavity, the superior or abdominal strait.
The inferior opening, the inferior or perineal strait.

Pelvic Cavity.

The pelvic cavity is limited above by the superior strait, and below by the inferior strait. It has four walls, one anterior, one posterior and two lateral.

Anterior Wall.—This is included between two imaginary lines running from the ilio-pectineal eminence to the internal face of the tuberosity of the ischium, and follows the external edge of the obturator canal. Here we find the pubic symphysis, and the prominence which we have already noticed in connection with the inter-pubic cartilage, the internal face of the body of the pubes, the obturator or sub-pubic canal, the internal face of the ischio-pubic ramus and of the tuberosity of the ischium (Dubois and Pajot).

Posterior Wall.—This is included between two lines which run from the anterior and superior part of the sacro-iliac symphysis to the inferior edge of the great sciatic ligament, close to its insertion on the sacrum and coccyx. It is triangular, and concave like the sacrum which forms its greater part.

Here are found: the anterior face of the sacrum and coccyx, the vertebral fossæ of the sacrum, the transverse lines which separate them and the anterior sacral foramina. In some cases the line which separates the first two pieces of the sacrum is so pronounced, as to be taken for the sacro-vertebral angle.

The importance of this error is plain, involving as it does the narrowing of the pelvis. (Dubois.) Its height, following the curve of the sacrum and coccyx, is about 5.8 inches.

The lateral walls are included between the lines which limit the anterior and posterior walls. They have a height of about 3.9 inches. They are divided into two inclined planes, the anterior and posterior, separated by a line which passes through the base of the sciatic spines.

The anterior plane is formed by a large part of the posterior face of the cotyloid cavity, and the posterior half of the internal face of the ischiatic tuberosity. In front it blends with the obturator fossa, which may be considered its natural prolongation.

The posterior plane is formed by the internal face of the sciatic spine, the anterior face of the two sciatic ligaments, the ischiatic foramina, the muscles and the nerve fibres which traverse these openings.

Three diameters can be distinguished in the cavity:

1. An antero-posterior diameter, A P, which runs from the middle of the posterior face of the pubic symphysis, to the union of the second and third pieces of the sacrum. It is about 4.5 inches in length.

2. The transverse diameter, T, which runs from one side to the other, crossing the diameter A P at right angles. It is about 4.5 inches long.

3. Two oblique diameters, O, which pass from the posterior face of each of the sub-pubic canals to the centres of the great sciatic foramina. They are about 4.5 inches.

The cavity is therefore about 4.5 inches in every direction. (Dubois and Pajot.)

The superior strait (Fig. 11) is bounded posteriorly by the sacro-vertebral angle and the anterior edge of the base of the sacrum; laterally by the linea innominata; in front by the ilio-pectinal eminence, the posterior edge of the horizontal ramus of the pubes, and the superior part of the body of the pubes, and of the pubic symphysis.

The superior strait has four principal diameters:

1. The antero-posterior diameter, A P D, sacro-pubic, sacro-sub-pubic, conjugate, conjugata vera of the Germans, the small diameter.

It extends from the superior edge of the pubic symphysis to the middle of the sacro-vertebral angle. It is from 4.2 to 4.5 inches long.

Pinard holds with Schrœder, that, from the obstetrical point of view, there is an express indication for measuring this diameter *not* from the superior edge of the symphysis, but from the promontory to that point of the symphysis which is nearest to it. For this point is, according to Schrœder and Pinard, ½ inch below the superior edge of the symphysis. It is this diameter which Pinard calls the minimum or useful diameter. Crouzat, continuing Pinard's measurements, admits that the post-pubic point is situated below the sub-pubic point about 4 tenths of an inch.

2. Transverse or bis-iliac diameter, the great diameter, extends from the middle of the linea innominata of one side to the same point on the opposite side. It is from 5 to 5.2 inches long.

3. The oblique diameters, right and left, extend from the anterior region of one of the iliac synchondroses to the ilio-pectinal eminence of the opposite side. They are from 4.6 to 4.9 inches long.

4. To these principal diameters we may add:

a. A sacro-pectineal diameter (of Burns and Pajot) running from the middle of the promontory to the superior edge of the horizontal ramus of the pubes, immediately below the sub-pubic angle. It is about 3.9 inches long.

b. A sacro-cotyloid diameter (Velpeau and Pajot), which runs from the middle of the promontory to the superior and posterior parts of the cotyloid cavity. It is about 3.5 inches long.

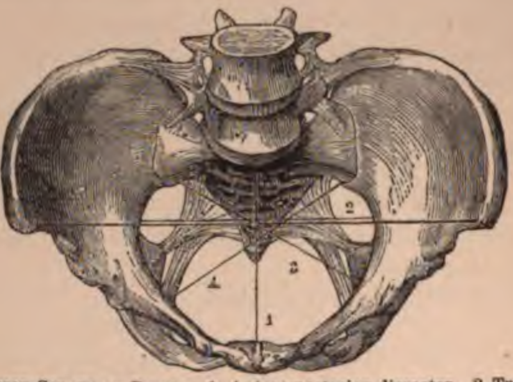


FIG. 11.—SUPERIOR STRAIT OF PELVIS.—1, Antero-posterior diameter. 2, Transverse diameter 4, Right oblique diameter.

The circumference of the superior strait measures about 16 inches.

The inferior strait (Fig. 12) is formed by two triangles, united by a common base. This base is formed by the line which joins the two ischiatic tuberosities. The anterior triangle has its apex at the pubic arch, the posterior at the tip of the coccyx.

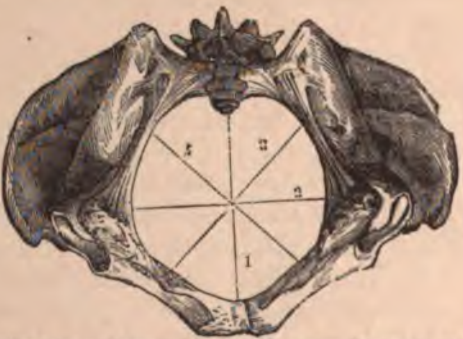


FIG. 12.—INFERIOR STRAIT OF PELVIS.—1, Antero-posterior diameter. 2, Transverse diameter. 3, 4, Oblique diameters.

The diameters of the inferior strait are:

1st. The antero-posterior, or coccy-pubic diameter, which extends from the tip of the coccyx to the top of the pubic arch.

2d. The transverse or bis-ischiatic diameter. This joins the centre of the two ischiatic tuberosities.

3d. The two oblique diameters extend from the middle of the inferior edge of the greater sciatic ligament to the middle of the opposite ischio-pubic ramus.

All these diameters are, on an average, 4.3 inches long. The coccy-pubic diameter is, however, very often less than this measurement, but during labor the backward movement of the coccyx lengthens this diameter by ½ to 1 inch, and even more in some cases.

The circumference of the inferior strait, instead of being regular like that of the superior, is very rough. It has three corners and three notches. The three corners are formed by the coccyx and the two ischiatic tuberosities. The three notches are formed by the edge of the greater sciatic ligaments, and by the pubic arch.

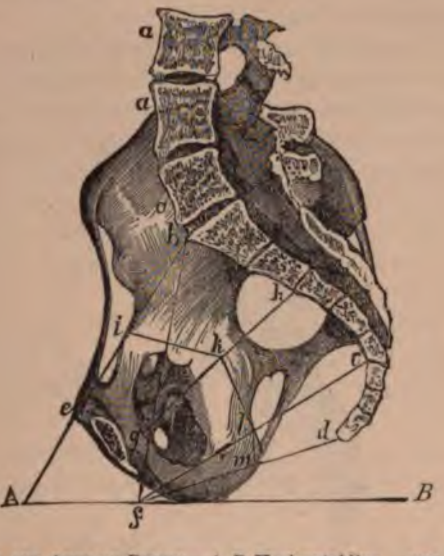


FIG. 13.—INCLINATION AND AXES OF PELVIS.—*A*, *B*, Horizontal line. *aaa*, Vertebræ. *b*, Promontory. *c*, *d*, *e*, Diameters of the pelvic inlet. *df*, Diameter of the outlet of the pelvis. *bf*, Conjugate diameter. *hg*, Right diameter of pelvis. *i*, *k*, *l*, *m*, Axis of smaller pelvis.

Finally there is the sacro-sub-pubic or promonto-sub-pubic diameter, which extends from the middle of the promontory to the median and inferior part of the triangular ligament of the pubic symphysis. It is, on an average, about 4.5 inches long.

Inclination, Direction, Planes and Axes of the Pelvis.

The pelvis articulates with the spinal column in such a way as to form an angle, the vertex pointing forward. This is the promontory or sacro-vertebral angle. The result is that the pelvis is not in the axis of the abdominal cavity, but is inclined in the upright position from above downwards, and from behind forwards. In this position, the sacro-vertebral angle is about 3.9 inches above a horizontal line, which passes from before backwards, and touches the superior edge of the symphysis. The coccyx is .7 of an inch above a horizontal line which touches the inferior edge of the symphysis. From this it results that the inclination of the plane of the superior strait is from 59 to 60 degrees, that of the inferior strait from 10 to 11 degrees (Naegelé-Danyau). (Fig. 13.)

(By the planes of the straits are meant, in obstetrics, those planes which pass through the diameter A P, and touch similar points on each half of the pelvis). (Tarnier and Chantreuil.)

Axes.—The axis of the superior strait is a line perpendicular to the plane of that strait at its middle point. Prolonged upwards and forwards this line meets the umbilicus; backwards and downwards it ends at the anterior surface of the coccyx.

The axis of the inferior strait, when prolonged upward and forward, meets the axis of the superior strait near the centre of the cavity, and ends at the sacro-vertebral angle, or a little above it, on the anterior face of the last lumbar vertebræ. When prolonged backward and downward it meets the perineum a little in front of the anus.

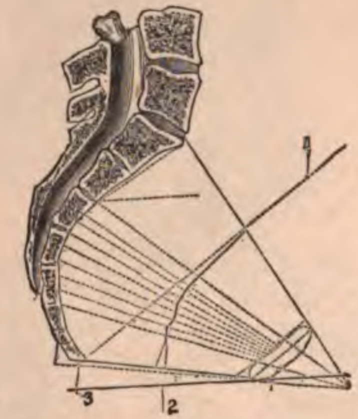


FIG. 14.—PLANES AND AXES OF THE PELVIS.

The axis of the cavity is a curved line passing through the centre of the true pelvis, and everywhere equally distant from the sacrum and the pubes.

The fœtus passes along this line in entering, crossing, and leaving the cavity. (Fig. 14.)

In the upright position, such is the direction and such are the axes of the pelvis; they vary of course with different attitudes. In the complete dorsal decubitus, which is the usual position of women in labor, in France, the plane of the superior strait faces from above downwards and from in front backwards, and its axis points from behind forwards, and from above downward. The plane of the inferior strait is thus inclined from above downward and from in front backwards. The axis of this strait then points downward and almost directly forward.

THE TRUE PELVIS IN GENERAL.

The walls of the true pelvis are unequal in length. The posterior wall is from 5.4 to 6.2 inches; the anterior wall along its median line is only 1.5 to 1.9 inches, and the lateral wall about 3.9 inches. Its capacity varies in different parts. The lateral walls represent two oblique planes which approach each other as they descend, thus giving to the pelvis the form of a cone, base uppermost. As to the anterior and posterior walls, the mobility of the coccyx allows the inferior strait to exceed the superior strait in the antero-posterior direction. Finally, towards the middle of the cavity, the projections of the sciatic spines make the pelvis narrower and seem to form a median strait between the other two.

From these facts result the following, according to Pajot:—

1. The fœtus cannot enter the cavity and cross it unless it does not exceed 5.7 inches for the superior, and 4.6 inches for the inferior strait. Therefore it must reach the superior strait by the vertex, or the opposite end of the trunk.

2. If the head of the fœtus enters the superior strait in dimensions equal to the transverse diameter, it is immediately stopped by the nearness of the walls before reaching the bottom of the true pelvis, and it cannot cross the inferior strait without diminishing in volume, or changing its direction. The result of this change would be the presentation of its greater dimensions in the direction of the diameter A P, or of one of the oblique diameters.

3. When the head of the fœtus has reached the bottom of the cavity, those of its parts which point backward are still applied to the posterior wall, while that which is in front will have already freed itself from the anterior wall, which is shorter, and corresponds to the pubic arch. It will then be free from the whole solid wall.

4. The fœtus cannot enter and cross the pelvis unless it first follows the direction of the axis of the superior strait, then crosses the true pelvis following the curved line, which is its axis; and finally, in order to issue forth, it must follow the direction of the axis of the inferior strait.

The fœtus must therefore bend and describe a curve with its concavity forward.

Differences in the Pelvis, according to the Individual, Sex, Age and Race.

The pelvis shows remarkable differences according to the individual, sex, age and race.

I. *Individual.*—Among women of the same race the pelvis, without ceasing to be normal, shows numerous variations. The thickness, the solidity of the bones, the points of the crests and eminences, larger or smaller, the height, the size, the variable curvature of the sacrum, the angle of the pubic arch, the different heights of the ossa innominata, constitute as many varieties. Yet with the younger Stein and Weber we distinguish four forms of the superior strait.

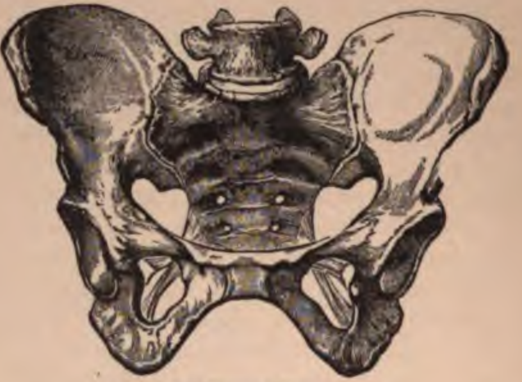


FIG. 15.—FEMALE PELVIS.

1st. The shape of the heart on a playing-card, with the point cut off.

2d. Elliptical, in which the transverse diameter is the greater.

3d. Round.

4th. Elliptical, in which the diameter A P is the greater.

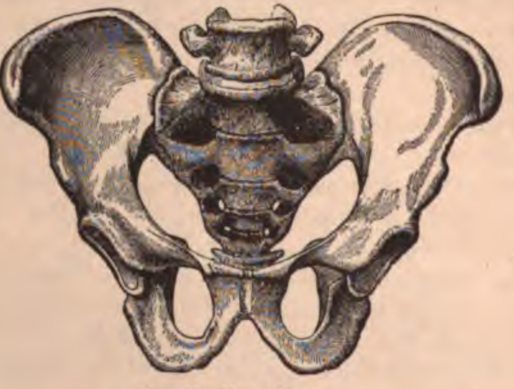


FIG. 16.—MALE PELVIS.

II. *Sex.*—The pelvis of a woman differs greatly from that of a man. (Figs. 15 and 16). The following are these differences, according to Dr. Verneau:

1st. In a pelvis there are sexal differences of two kinds: the first, analogous to those which are found in the rest of the skeleton, relate to the marks left by the muscular system; the second are peculiar to the pelvis.

2d. The real differences between the pelves are found almost exclusively in the true pelvis, and are determined by the presence of the uterus.

3d. The form of the superior circumference is the same in both sexes, the ratio of the maximum of the antero-posterior to the maximum transverse diameter is in both 0.62.

4th. All the dimensions of the internal iliac-fossa are less in woman, except the distance which separates the antero-superior iliac spine from the sacro-iliac articulation.

5th. The internal iliac-fossa is shallower in the female.

6th. The dorsal part, the iliac tuberosity, is much more developed and sharper in man.

7th. In woman the spines of the pubes are further apart.

8th. In the latter all the diameters of the superior strait are greater than in man. The difference is specially noticeable in the transverse diameter.

9th. In a female pelvis the superior strait is rounder; this follows in part from the increase of the maximum transverse diameter, and in part from the position of this diameter, which is further forward than in man.

10th. In the latter the great sciatic notch is narrower and deeper.

11th. In man the apex of the sciatic spines is sometimes inside of the postero-inferior iliac spines; in woman it is always outside.

12th. The distance which separates the sciatic spines is rarely greater than 4 inches in man, it may even be below 3 inches.

13th. In woman the distance between the sciatic spines often exceeds 4 inches, and is never less than 3 inches.

14th. The antero-posterior diameters are only a few hundredths of an inch long.

15th. The pubic angle is greater in woman (75° for woman, 58° for man.)

16th. The apex of the above angle is rounder in the former. The ischio-pubic tubercle is pointed outward, and the ischio-pubic ramus is concave near its middle.

17th. In woman the sacrum and coccyx are lower and flatter.

18th. The acetabulum is smaller and faces less backwards and inwards.

19th. The distance of the two cotyloid cavities is greater when they are measured internally, and smaller when measured to the ilio-sciatic notches.

20th. The sub-pubic canal is oval in man, triangular in woman. It is relatively larger in the latter and slopes more outward and downward.

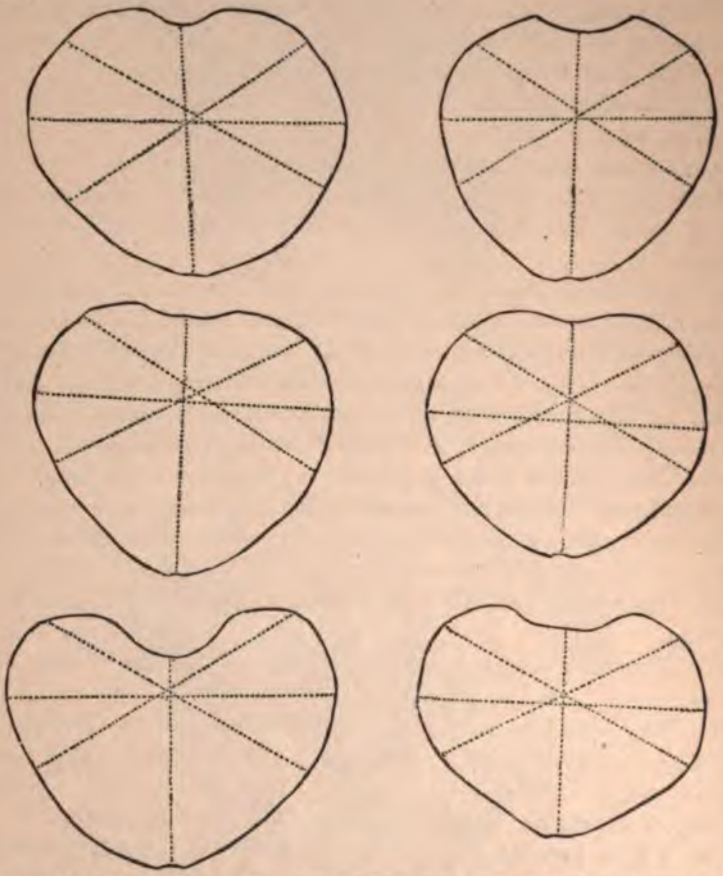
21st. The distance between the ischia is greater in woman.

22d. All the vertical diameters are greater in man.

23d. The total height of the pelvis in man is, on an average, 8 inches, while in woman it is but 7.6 inches.

24th. In the male pelvis the distance from the sciatic spine to the highest point of the iliac crest reaches, on an average, 6.5 inches; in the female pelvis it is only about 5.8 inches.

25th. The distance from the sciatic spine to the antero-superior iliac spine is, on an average, in woman, 5.3 inches; in man this average reaches 5.8 inches, a figure which the maximum distance in the former never reaches.



FIGS. 17 TO 22.—DIFFERENT FORMS OF THE SUPERIOR STRAIT IN WOMAN. (*Verneau.*)

1. French. 2. Negress.
3. Peruvian. 4. Indian (Brazil.)
5. Chinese. 6. Bosjesman.

26th. The interval between the antero-superior iliac spine and the inferior part of the ischium is 6.4 inches in the pelvis of a woman, and averages 7 inches in that of a man. The maximum in the former never attains this last figure.

III. *Age.*—In the new-born child the differences of sex are not well-marked. The alæ of the sacrum are extremely small compared to that of the vertebra; the alæ are also nearly straight. The anterior face is more concave transversely, its inclination is less, and it is not set so deeply between the iliac bones. The horizontal rami of the pubes are extremely short. The iliac alæ are straighter; the distance which separates the iliac spines is equal to that which separates the crests. The diameter A P equals or exceeds the transverse diameter.

As for the causes which lead to the transformation of the pelvis of the new born into the adult pelvis, the first is the development of the sacrum, and particularly its wings; then follows the weight of the trunk on the feet. This tends to force the sacrum into the pelvis; but since the centre of gravity of the trunk is in front of the supporting point of the sacrum, this bone makes a rotatory movement on its axis which lowers the promontory, and has a tendency to throw the point of the sacrum backward. Now this point is held by ligaments, therefore the sacrum ought to curve on its anterior face.

Race.—As Pajot observes, it is especially in the two extremes of the human scale that the most striking differences and distinctions are to be found:—namely in the white race, on the one hand, and the Ethiopian negro, on the other. Vrolik, Dubois and Pajot, Joulin, Verneau, the Anthropological Society, Reynaud and Rey, have published interesting works on this question. We will confine ourselves to referring the reader to Figures 17 to 22. They represent the various forms of the superior strait of the women of different races, showing the differences which characterize the pelvis, taking the French as a common European type, down to the negroes and the Bosjesman.

Functions and Movements of the Pelvis.

The pelvis of woman, says Pajot, plays an indispensable part in the accomplishment of two important functions, generation and locomotion. It serves moreover to support, contain, and protect several essential organs.

The pelvis supports the trunk and upper extremities; therefore it is formed of large, resisting bones, so placed as to make a complete ring. This ring resists the strain by the aid of two essential conditions: the strength of the bony elements which form it, and the direction in which it is interposed between the vertebral column and the lower extremities.

The strength of the bone is especially remarkable in the sacrum, in that portion of the ossa innominata which lies between the articular facet and the cotyloid cavity, and the portion which forms the base of the ischium.

The pelvis is placed between the vertebral column, and the inferior extremities, so as to form a very oblique ring. This ring receives the weight of the trunk on its highest point, and it is supported by the femurs at its anterior and lateral parts. Now this ring may be divided into two nearly equal parts, or two arcs. The superior arc sustains, at its centre, the vertebral column; it ends at the cotyloid cavities, and the femurs. The centre of the inferior arc is the pubic symphysis; it also ends at the cotyloid cavities where it joins the superior arc.

The superior half forms an arch which completes and strengthens the inferior half, which is shaped like an inverted arch. (Dubois and Pajot).

The pelvis protects the viscera, and in its interior the development of the organs and of the fœtus takes place.

The movements of the pelvis are very limited on account of the mode of union of its various pieces. Yet it has movements of flexion, of extension, of lateral inclination, of rotation about a vertical axis, and even of circumduction (Tarnier). Movements of the bones among themselves only exist in the sacro-cocygeal articulation. If, during pregnancy, the swelling and imbibition of the interarticular cartilages separate the bones a little, it is not enough to justify the opinion of the ancients, who thought that the bones could move so as to cause a dilation of the pelvis. In the pubic symphysis these phenomena are the most pronounced, but it is only in pathological cases, called relaxation of the symphyses, that these movements become appreciable. Matthews Duncan has made a study of the articulations of the pelvis during confinement. We will confine ourselves to mentioning this work, to which we will return later.

Soft Parts of the Pelvis.

The pelvis is covered on the inside and outside by soft parts. The first of these have a direct relation to pregnancy and confinement; the others on the contrary, can only be called accessories. We will pass rapidly over these last, before making a careful study of the former.

Soft Parts of the External Surface.

Those which are posterior are only of a secondary interest. With the exception of the glutei-maximi muscles, which unite to form a part of the perineal floor, none of these parts have any direct relation to the object of our research. It is not the same with those which are situated anteriorly. These may be divided into two classes: those which belong essentially to the pelvis, and which form the region of the external genital organs; those which form only accessorily a part of the pelvis, and which close the great notch in the anterior part of the pelvis. We will first describe the abdominal walls.

I. *Abdominal Walls.*

Only the lower third of the abdominal wall helps to close the pelvis in front; that is, only the hypogastric region. We must not, however, forget the part which the abdominal walls play in the act of parturition: we will, therefore, say a few words about that portion which forms the abdomen. Following Richet, we distinguish four walls—

1st. The superior wall, formed by the diaphragmatic region.

2d. The posterior wall formed by the lumbar portion of the great spinal region.

3d. According to Richet there is no inferior wall, unless with Blandin we regard the perineal floor as such. If this opinion of Richet is true from a surgical point of view, it is not from the obstetrical, for all obstetricians consider the perineal floor as the floor of the pelvis.

4th. There only remains the antero-lateral wall; and this deserves our whole attention.

Considered as a whole, it forms a sort of contractile band, of a lozenge shape. It extends from the edge of the last ribs, laterally, to the iliac crests, and from the notch which the ribs form in leaving the sternum to that formed by the anterior iliac spines. It may be divided into two sections: the anterior, limited by the external edge of the recti muscles; the lateral limited at the back by the anterior edge of the quadratus lumborum and the sacro-lumbalis muscles.

II. *Anterior Abdominal Region.*

It is bounded externally by the external edge of the rectus muscle, above by the ensiform cartilage, below by the pubic symphysis. Proceeding from without inward it is formed by:

1st. The skin, which is very loosely attached to the subjacent tissues, except at the level of the umbilicus.

2d. The sub-cutaneous layer, which is divided into two laminæ or fasciæ, which cross those of the opposite side at the median line, and adhere to the linea alba.

3d. The linea alba: an aponeurosis formed by the union of fibrous layers which extend from the oblique and transverse muscles of the abdomen. It is really composed of four layers, one proceeding from the external oblique muscle, two from the aponeurosis of the internal oblique, which is in fact formed of two layers, and, finally, one proceeding from the transversalis muscle.

Having arrived at the external edge of the recti these layers separate; that of the external oblique, uniting with that of the internal oblique, passes in front of the rectus muscle, while the deep layer of this last muscle, united to that of the transversalis, passes backward. The rectus muscle is thus enclosed in a solid and resisting aponeurotic sheath.

This sheath is, however, incomplete below. There the layer of the internal oblique muscle becomes thinner, until it only forms a membranous sheath; but it is replaced by another fibrous lamina, the fascia tranversalis.

At the internal edge of the rectus muscle, these four layers again unite, and form a solid resisting membrane, the fasciculated fibres of which pass obliquely towards the median line, where they cross those of the opposite side at more or less acute angles. This is the linea alba.

4th. The recti muscles, inclosed within the aponeurotic sheath which has just been described.

4th. The sub-peritoneal cellular tissue.

6th. The peritoneum and the abdominal cavity.

Here also are found: arteries, proceeding from the internal mammary, which inosculate from above downward with the epigastric, and laterally with the terminal branches of the lumbar and intercostal arteries; nerves; lymphatics going to the axillary and inguinal glands; some to the glands which surround the iliac artery, and, finally, nerves from the last dorsal and lumbar branches.

The umbilicus is the cicatrix resulting from cutting the umbilical cord.

Lateral Abdominal Region.

It is bounded in front by the external edge of the rectus muscle, behind by the anterior edge of the latissimus dorsi, the sacro-lumbalis and the quadratus lumborum; above by the ribs; below by the iliac crest and femoral arch. It is remarkable for containing the inguinal canal.

Richet divides it into two parts: a superior lateral region of the abdomen, and inferior lateral, or ilio-inguinal region.

Superior Lateral Region.

Proceeding from without inward we find:

The skin; the subcutaneous layer, which is divided into a superficial lamina, or fascia superficialis, and a deep lamina. An aponeurosis, which covers the muscular fibres; the external oblique; the internal oblique; the transversalis; a cellular layer; the fascia propria transversalis; the peritoneum; the lower intercostal and lumbar arteries; some veins; nerves from the anterior branches of the last intercostals, and some abdominal branches of the lumbar plexus; finally, lymphatics, which proceed to the axillary, inguinal, iliac, lumbar and intercostal glands.

Inferior Lateral or Ilio-inguinal Region.

Passing from without inward we find:

The skin; the subcutaneous layer; the prolongation of the cellular layer which covers the fibres of the external oblique; the tendinous insertion of the external oblique; the femoral arch; fibres forming the fibrous, or true fascia transversalis; often, but not always, a cellular layer which forms the fascia transversalis; the peritoneum; the epigastric, the circumflex, the iliac and the abdominal cutaneous arteries. The nerves are of little importance; the lymphatics proceed to the ganglia lying above the femoral arch, and to the iliac ganglia. (Richet.)

Just below and to the inside of the pubic spine, and between this spine and the symphysis, the aponeurosis of the external oblique divides into two diverging bands, which enclose an oval opening; this is the inguinal ring, the external orifice of the inguinal canal. This canal is deep within the musculo-aponeurotic sheath of the abdomen, just above the femoral arch, which forms its inferior wall. It is traversed by a round ligament, which, in the fœtus, is accompanied by the peritoneum, thus forming a cul-de-sac called Nuck's canal. (Tarnier.)

The Muscles of the Internal Surface of the Pelvis.

The internal surface of the pelvis is covered with very important muscles which modify its character and form. They are:

The Psoas and Iliacus Muscles.—A pair of muscles, which fill the grooves on each side of the promontory, and the internal iliac fossæ. Composed of two bundles, the psoas and iliacus, which form a single muscle, arises, on each side, by its psoas fascia from the lateral and superior parts of the body of the lumbar vertebræ and the last dorsal; by its iliac portion from the whole of the internal surface of the internal iliac fossa; then

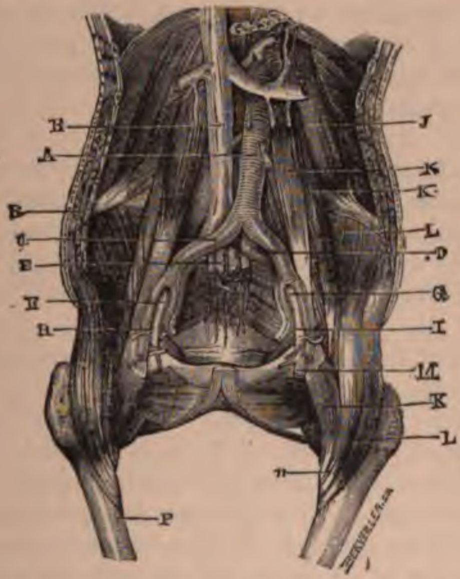


FIG 23.—THE PELVIS COVERED WITH ITS SOFT PARTS.—*A*, Aorta. *B*, Inferior vena cava. *C*. Common iliac artery. *D*, Common iliac vein, *E*, Sacro-vertebral angle. *F*, Hypogastric artery, *G*, Hypogastric vein. *H*, External iliac artery. *I*, External iliac vein. *J*, Quadratus lumborum. *K*, *K'*, Psoas muscles. *L*, Iliac muscles. *M*, Iliac aponeurosis. *N*, Tendon of the psoas-iliacus. *O*, Obturator externus. *P* Femur *Q*, Greater trochanter. *R*, Muscles of the anterior abdominal wall.

the fascia as a whole passes over the ilio-pectinal eminence, and a part of the horizontal ramus of the pubes, below the femoral arch, and inserts into the trochanter of the femur. Sometimes a small part of the fascia separates from the superior end of the psoas, and is attached at the ilio-pectinal eminence: this is the psoas parvus.

An aponeurosis, called the fascia iliaca, covers the psoas-iliac muscles. It is placed above and outside the ilio-lumbar ligament, below the femoral arch, and the aponeurosis of the fascia lata of the thigh.

It divides into two layers: a deep and a superficial, which form a sheath for the iliac vessels and lymphatic glands.

Along the internal edge of the muscle the external iliac artery and vein are found.

Between the promontory and the sacro-iliac synchondrosis the common iliac artery and vein pass, also the upper part of the internal iliac artery and vein.

The left lateral part of the iliac muscle is covered by the colon, the right lateral part by the cæcum; the rectum begins above and to the left. Finally, in front, is the bladder, and laterally the peritoneum.

To this region belong the femoral and genito-crural nerves, which arise from the lumbar plexus.

The crural nerve springs from the second, third and fourth lumbar nerves, which make a sharp angle to form it. It crosses the psoas along its external edge, being placed between the iliac muscle and the fascia iliaca; it then passes under the femoral arch, separated above from the iliac vessels by the entire thickness of the psoas; it approaches it below, and is separated from it by only a fibrous partition, a portion of the fascia iliaca.

The genito-crural nerve is the lowest of the branches of the lumbar plexus; it crosses the psoas on the level of the vertebral insertions, descending the length of the common and external iliac arteries, and divides, either on the level of the ligament of Fallope, or below it, into an external or femoral branch, or into an internal or genital branch.

In the cavity, the sub-pubic or obturator fossæ, are filled by the obturator muscles, which are attached partly to the rim of the obturator fossa, then leave the pelvis by the sciatic foramen, and pass to the digital fossa on the greater trochanter.

A special aponeurosis covers the muscles.

Behind the symphysis is the bladder, and the peritoneum that covers it, held by two lateral fibrous cords; these are the anterior ligaments of the bladder.

The anterior surface of sacrum and coccyx is covered by the rectum, which, above, in front of the left sacro-iliac symphysis, reaches the median line towards the middle of the sacrum. It adheres to these parts by a loose peritoneal fold, the meso-rectum. Reaching the end of the coccyx, it is carried forward, and, for a distance of seven to eight inches, crosses the muscles to an orifice which forms the anus.

The lateral parts of the sacrum, externally to the greater sciatic notch, and the anterior sacral canals, are occupied by the pyramidalis muscle. It stretches over the osseous spaces which separate the anterior sacral canals, across the greater sciatic notch, to the internal surface of the great trochanter. The anterior branches of the sacral nerves, which form the sacral plexus, the hypogastric artery and vein, cross this muscle.

A true aponeurosis covers the pyramidalis muscle.

Finally, the aponeurotic and peritoneal lamina cover those portions of the cavity which are not covered by either muscles or viscera.

Floor of the Pelvis.

We shall borrow the greater part of our anatomical description from Dubois and Pajot, for in their work this intricate part is most clearly explained.

The floor of the pelvis, inferior wall of the pelvis, perineal floor, perineum, is formed by a muscular aponeurotic plane, pierced by three openings, the anus, the vulva and the orifice of the urethra, which open on its surface. It forms an elastic couch, which plays an important part in delivery.

Two very distinct parts can be distinguished: an aponeurosis, formed of layers which unite and make distinct spaces, and muscles, which fill these spaces and are accompanied by important vessels and nerves.

Superior Pelvic Aponeurosis. (*Figs.* 24 *and* 25.)

Proceeding from within outwards, the first aponeurosis is the superior pelvic aponeurosis. Attached behind to the anterior surface of the sacrum and coccyx, inside to the sacral canals, and in front on the internal surface of the body of the pubes, near the symphysis, it extends along the entire wall of the pelvis, excepting the superior half of the anterior semicircumference. On a level with the edge of the abdominal strait, it blends in front with the aponeurosis of the abdominal walls; laterally with the iliac muscle; behind with the lumbo-iliac aponeurosis. Below it covers the entire floor of the pelvis like a kind of inferior diaphragm.

On a level with the superior border of the great sciatic notch, it divides into two laminæ which, twisting at almost a right angle, form a transverse partition that divides this aponeurotic cavity into two parts, the anterior, which is the larger, and the posterior. These two laminæ, joined by their superior edge, turn aside at their inferior part, thus forming a triangle, base downward.

Their internal portion meets the rectum and vagina, with the walls of which they blend, their external portion reaching the soft parts, which occupy the ischiatic canal. The perineal portion is crossed by the rectum behind, the vagina in front, and finally, still further forward, by the bladder, the lower end of which projects slightly below the level of the aponeurosis. As Pajot says, it is not a true perforation that the aponeurosis undergoes, for the edges of these openings turn up from below, and prolong into fibrous expansions on the walls of each of the organs which they traverse. This is particularly noticeable in the bladder and vagina.

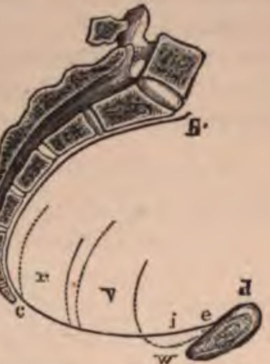


FIG. 24.—SUPERIOR PELVIC APONEUROSIS.—Anterior vertical section (*Pajot*). *b*, *c*, *i*, *e*, superior pelvic aponeurosis. *d*, pelvic symphysis. *r*, rectum. *v*, vagina. *w*, bladder. *i*, *e*, part of the superior pelvic aponeurosis pushed back by the bladder.

The parietal portion covers the sacrum, the coccyx, the anterior branches of the sacral nerves, the pyramidalis muscle and its aponeurosis, the superior part of the obturator and its aponeurosis, and lastly the superior half of the body and symphysis of the pubes. Therefore, it occupies at the same time, the cavity and the inferior strait.

The other aponeuroses occupy only the anterior half of the inferior strait. They are three in number and are called the perineal aponeuroses.

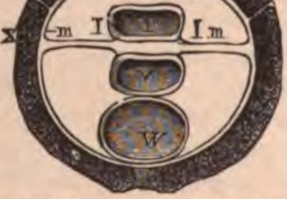


FIG. 25.—TRANSVERSE SECTION OF THE SUPERIOR PELVIC APONEUROSIS (*Pajot*). R, rectum.—V. Vagina.—W. bladder.—*m*, *m*, transverse partition formed by the superior aponeurosis dividing into two laminæ. *l*, *l*, internal extremity of this transverse partition.

II. *Perineal Aponeuroses.*

These extend vertically, from the body and symphysis of the pubes, to an imaginary line drawn between the two ischiatic tuberosities. They are limited transversely, by the ischio-pubic rami to which they unite.

They are placed one under the other, forming true compartments by the union of their posterior edges at the level of the imaginary bis-ischiatic line. They are crossed by the urethra and vagina, but not by the rectum, which lies below.

Proceeding from behind forwards, and from within outwards these aponeuroses may be divided into:

a. *Deep Perineal Aponeurosis.*—It is attached above to the lower surface of the triangular ligament, laterally to the internal face of the ischio-pubic rami, near the sub-pubic canal, and to the internal face of the ischiatic tuberosities. Crossed by the urethra and vagina, it adheres to this canal, behind the constrictor or sphincter vaginæ. Its posterior edge, on a level with the bi-ischiatic line, curves from above downward, and from in front backward, in order to unite with the two other perineal aponeuroses.

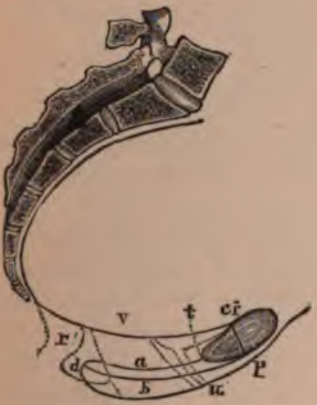


FIG. 26.

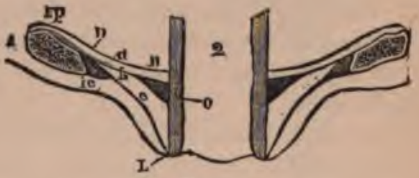


FIG. 27.

FIG. 26.—APONEUROSES OF THE PERINEUM.—ANTERO-POSTERIOR VERTICAL SECTION. (*Pajot*).—*a*, *b*, *c*, deep, medium, and superficial aponeuroses of the perineum. *r*, rectum. *v*, vagina. *u*, urethra. *p*, pubis. *ci*, insertion of the superior pelvic aponeurosis on the pubes. *t*, insertion of the perineal aponeurosis on the pubes. *d*, posterior edge of the deep perineal aponeurosis, blending with the posterior edge of the median and superficial perineal aponeuroses.

FIG. 27.—APONEUROSES OF THE PERINEUM. TRANSVERSE SECTION.—(*Pajot*).—1, ischio-pubic rami cut horizontally. 2, the vagina cut from in front backwards. L, the labia majora cut in the same way. *a*, deep perineal aponeurosis. *b*, medium perineal aponeurosis. *c*, superficial perineal aponeurosis. *ip*, insertion of the deep perineal aponeurosis on the posterior surface of the ischio-pubic rami. *m*, insertion of the same aponeurosis on the lateral parts of the vagina. *n*, insertion of the medium perineal aponeurosis on the internal face of the ischio-pubic ramus. *o*, division of this same aponeurosis into two laminæ and the insertion of these on the vagina after enveloping the sphincter, or constrictor vaginæ muscle. *ic*, divisions of the superficial perineal aponeurosis and its insertion on the ischio-pubic ramus, enveloping the ischio-cavernous muscle and the corresponding root of the clitoris. L, insertion of the same aponeurosis on the deep surface of the labia majora at a point corresponding to where the skin of this part blends with the mucous membrane.

b. *Median Aponeurosis.*—It is attached to the anterior face of the body of the pubes behind the clitoris, then to the internal surface of the ischio-pubic rami. Like the deep perineal aponeurosis, it is crossed by the urethra and vagina, and seems to turn on itself to sheathe this canal and attach itself there, enveloping the constrictor or sphincter vaginæ. Its posterior edge blends with the posterior edge of the deep aponeurosis. (See Figs. 26 and 27.)

c. *Superficial Aponeurosis.*—Above, it is inserted on the anterior face of the body of the pubes, covering the root of the clitoris, and blending with the abdominal aponeurosis, laterally on the external surface of the ischio-pubic rami. There it turns to envelop the sphincter vaginæ, and the roots of the clitoris. Behind it blends, by its posterior edge, which curves from below upwards, and from in front backwards, with the edges of the middle and deep aponeuroses.

Thus traversed by the urethra and the vagina, the edges of these aponeuroses penetrate deep into the labia majora, and are inserted in the deep layers of skin of these labia at the point where the skin is united to the internal membrane of the vagina.

Above is the skin, which is pierced by three openings, the anal, the vaginal and the urethral.

Muscles of the Perinæum.

These are: the levator ani, the ischio-coccygeus, the sphincter ani, the constrictor vaginæ, the transversus perinei, and the ischio-cavernous.

Pajot describes together the levator ani and the ischio-coccygeal.

The Levator Ani and Ischio-coccygeus.—A double symmetrical muscle, it forms a layer stretched above the superior strait. We have to consider the superior concave surface, the inferior convex surface, and the circumference.

In front, it is inserted on the internal surface of the body of the pubes, very close to the symphysis, on the posterior surface of the horizontal ramus of the pubes, on a fibrous arch, the pubo-sciatic, which spans the space between the inferior edge of the pubes and the sciatic spine, on the edge and apex of the sciatic spine, and on the anterior face of the lesser sciatic ligament. From these various attachments its fibres radiate inward to a fibrous raphé which extends from the coccyx to the rectum, and are attached to the lateral walls of the rectum, to the raphé between the rectum and the vagina, to the lateral edges of the vagina, and to the lateral walls of the bladder.

Those fibres which pass from the sciatic spine, and from the sciatic ligament, to the coccyx, form the ischio-coccygeal muscle. This muscle thus forms the posterior fasciculus of the levator ani.

Immediately below the superior pelvic aponeurosis the levator ani is covered on its inferior or convex surface, at least anteriorly, by an aponeurotic layer, the inferior aponeurosis of the levator ani. Budin, in a recent work, calls attention to a contraction of the fibres of this muscle which Hildebrandt had already mentioned, and which may become, in certain cases, a true cause of tedious labor.

The External Sphincter Ani.—This is a muscular ring which surrounds the lower extremity of the anus. Of an elliptical shape, its fibres extend from the apex of the coccyx to the posterior part of the rectum which it completely surrounds. In front the fibres cross each other; those on the right pass to the left, those on the left pass to the right. They there inclose the orifice of the vagina and form the

Constrictor Vaginæ.—The fibres of this muscle begin where those of the sphincter ani cross; they are attached to the inferior extremity of the vagina enveloping the bulb of the vagina. When they reach the anterior part of the vagina, the two fasciæ surround the orifice of the urethra. They then reach the clitoris, to the roots of which they are attached, and blend with the superior end of the ischio-cavernous muscles. The constrictor vaginæ and sphincter ani form a figure of eight.

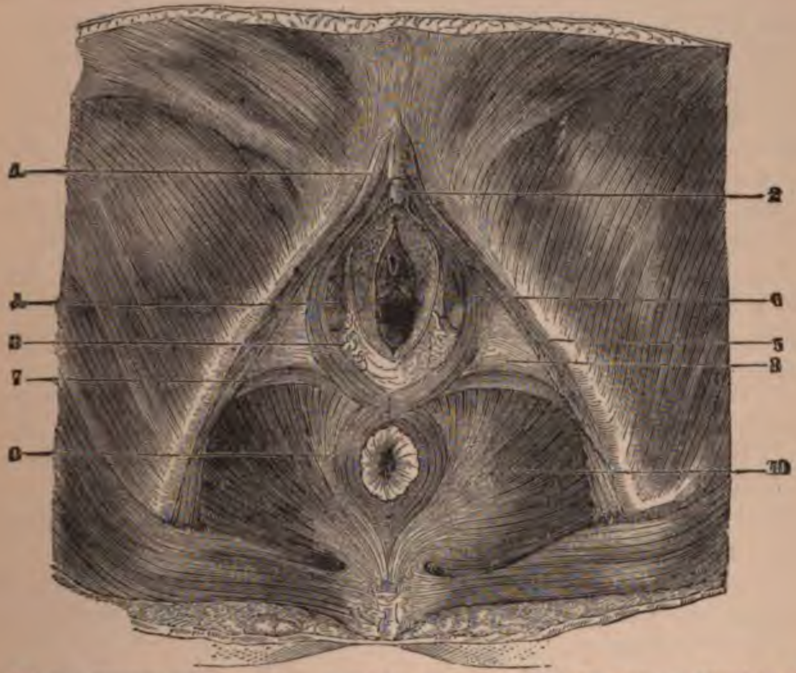


FIG. 28.—MUSCLES OF THE PERINEUM IN WOMAN.—1. Root of the clitoris. 2, Gland of the clitoris. 3, Bartholin's gland. 4, Bulb of the vagina. 5, Ischio-cavernous. 6, Constrictor vaginæ. 7, Transversus perinei. 8, Middle aponeurosis. 9, External sphincter ani. 10, Levator ani (*Beaunis* and *Bouchard*).

The Transversus Perinei.—A pair of symmetrical muscles; they are formed by two small fleshy bundles, which spring from the internal surface of the ischiatic tuberosities below the ischio-cavernous muscles, and between the insertions of the middle and superficial perineal aponeuroses. They then pass into the space which separates the vulva from the anus.

There they blend with the fibres of the opposite transversus, with the sphincter ani, and with the constrictor vaginæ.

The Ischio-cavernous.—These are a pair of symmetrical muscles situated on the inferior border and internal surface of the ischio-pubic rami. They originate at the ischiatic tuberosities, and the ischio-pubic rami, envelop the root of the corpus cavernosum of the clitoris, and end at the fibrous envelope of the corpus cavernosum, very close to the superior attachment of the constrictor vaginæ.

The two fascia of the constrictor vaginæ are encircled by the twofold vaginal division of the middle perineal aponeurosis:—the ischio-cavernous, by the ischio-pubic division of the superficial perineal aponeurosis.

Finally, the superior part of the glutei maximi muscles cover, with the coccygeal and sacral fibres, the whole of that part of the perineal strait which lies between the inferior edge of the greater and lesser sciatic ligaments, and two lines which run from the apex of the coccyx to the middle of the ischiatic tuberosities. Some nerves and numerous vessels are distributed to the pelvic floor.

The peritoneum forms the deepest part of the pelvic floor. It covers the pelvic aponeurosis, from which it is separated by a layer of cellular tissue, which communicates freely with the cellular tissue of the broad ligament, and which is most abundant in two points:

1. Between the skin and the superficial perineal aponeurosis, *i.e.*, within the pubic arch.
2. In what is called the ischio-rectal cavity—the ischio-rectal fossa.

Ischio-rectal Fossæ.—These are two cavities symmetrically placed outside of the anus and of the extremity of the rectum. . Each fossa has two walls, two extremities, a base and an apex.

Posterior Wall.—It is formed by the posterior and inferior part of the aponeurosis of the obturator internus. It ends above at a fibrous band called the pubo-sciatic.

Superior-internal Wall.--It is formed by the levator ani and the sphincter ani.

The anterior extremity is formed by the union of the internal and external walls with the posterior border of the perineal aponeuroses.

The posterior extremity is formed by the interior border of the gluteus maximus.

The base is turned towards the skin, and extends, on the one hand, from the inferior border of the gluteus maximus to the posterior edge of the perineal aponeuroses; on the other, from the ischia to the anus.

The apex results from the union of the internal and supero-internal walls.

The ischio-rectal fossa is filled with adipose tissue, the quantity of which varies with the individual.

The Coccygeal Gland.

This small gland was discovered by Luschka. It is the size of a pea, and is situated at the point of the coccyx between the tendons of the levator muscles at their cocygeal insertion and at the superior extremity of the sphincter ani. Nerves pass to it.

Its structure and functions are not well known.

Modifications produced in the bony Pelvis by the Presence of the soft Parts.

In the greater pelvis, the presence of the iliac and psoas muscles modifies the depth of the iliac fossæ, and transforms the superior strait into a curvilinear triangle. The base of this triangle is in front, and its truncated apex points backward.

The diameters of the pelvis suffer the following changes:—

1st. The antero-posterior diameter loses about .2 of an inch by the presence of the bladder and rectum.

2d. The oblique diameters, on account of the presence of the pyramidalis and obturator muscles, also lose about .2 of an inch.

3d. The transverse diameter loses about .6 of an inch, on account of the psoas-iliacus muscles.

All the diameters are therefore shortened to nearly the same degree.

In the cavity, the presence of the soft tissues diminishes all the diameters by about .2 of an inch

As Pajot says, the floor of the pelvis is extensible, and therefore, during confinement, the pelvis forms a canal, of which the opening is always at the superior strait, but the terminal extremity of which is formed by the distended vulva. The canal is therefore much longer and much more curved than the bony pelvis. The posterior wall is formed of two parts, one bony and about 9.6 inches long;—the other, soft and extensible, which may reach 5.8 inches. The lateral walls are also two, one bony, the other formed by the lateral regions of a greatly extended perinæum. Finally, the anterior wall is formed almost entirely by the pubic symphysis, and the body of the pubes, and accessorily by the urethra and the upper part of the vagina. The central line, which the fœtus must traverse is, then, nearly semi-circular, and the axis about which it must turn in leaving this canal is represented by the symphysis. It is also this line which the hand of the obstetrician must follow in crossing the pelvis from below upward, and from without inward.

CHAPTER II.

THE INTERNAL GENITAL ORGANS.

THE genital apparatus of woman is composed of:—1st, ovaries, which produce and hold the ovules; 2d, tubes, which conduct these ovules to the interior of the uterus; 3d, the uterus, or womb, the organ where the fertilized ovule developes; 4th, the vagina, the copulatory organ, which receives the fertilizing fluid, and transmits outside the product of the fertilization; 5th, the vulva, or entrance of the vagina, which serves at the same time for copulation, and for the exit of the fœtus.

The genital organs are divided into the internal and external. The first being by far the most important, we will begin by studying them.

THE OVARIES.

The ovaries are the essential organs of woman's genital apparatus. Thus their analogy with the testicles caused the ancients to name them the Testes muliebris.

Position—Direction—Volume—Shape—Attachments.

They are situated in the posterior layer of the broad ligaments, at the side of the uterus, behind the tubes and the round ligament, and in front of the rectum. They are ordinarily separated from the rectum by loops of intestine.

They are attached to the uterus by a round and resisting ligament, the ligament of the ovary, and to the lateral walls of the pelvis by the broad ligaments. Thus, placed within a fold of peritoneum, they are, at the same time, fixed and movable. This mobility allows them to follow the displacement of the neighboring organs. (See Fig. 33.)

Their position in the posterior fold gives them movements of displacement from above downward, and from below upward, from without inward, and from within outward.

The displacements due to the laxity of the broad ligaments are especially caused by the fact that the bladder, in distending, pushes the womb and the broad ligaments backward and downward. The ovaries then rest against the sides of the middle portion of the intestine, above the utero-sacral ligaments.

These displacements, due to increase of the uterus, cause the ovaries to occupy successively the pelvic cavity, the hypogastrium, the umbilical region, and finally the iliac regions. After delivery the ovaries lie in the iliac fossæ.

The pathological displacements are extremely varied.

The direction of the ovaries is transverse.

Their volume varies with age, and with the state of evolution of the ovules. They have, in general, the following dimensions:

Transverse diameter	1.2 inches, length.
Vertical diameter	.7 of an inch, height.
Antero-posterior diameter	.6 inch, thickness.

Their weight is, on an average, from 90 to 120 grains.

Shape.—They are shaped like an ovoid, long in the transverse direction, and slightly flattened from before backwards. They have two surfaces, two edges, and two ends.

The surfaces are smooth, uniform, and whitish, until puberty, becoming, however, more and more irregular as the cicatrices, due to ovulation, increase. They then become yellowish-brown, and have a rough and wrinkled aspect.

The antero-posterior surface faces upward and forward, the postero-inferior downward and backward.

The edges are turned transversely from within outward.

The superior and posterior edge is convex. The inferior and anterior is rectilinear, and is attached to a fold of peritoneum which forms the posterior layer. This is the hilum of the ovary.

The arteries enter and the veins and lymphatics leave the ovary by this edge. At the external extremity of this edge are attached the ligament of the tube, and the ligamentum teres, or lumbar ligament; to the internal extremity is attached the ligament of the ovary.

The ligaments of the ovary are three in number:

1st, The ligament of the ovary. This is a cord about .1 inch long, and .15 of an inch in diameter. It is composed of muscular fibres which blend, within, with those of the posterior face of the uterus, and, without, with the internal extremity of the inferior edge of the ovary.

2d, The ligament of the tube. It is formed by that fringe of the pavilion of the tube, which extends to the external extremity of the adherent edge of the ovary. This fringe contains muscular fibres, some of which, at the level of the hilum, blend with those of the ligament of the ovary; the greater part, however, pierce the thickness of the organ.

3d, The posterior round ligament. This was first mentioned by Rouget, and is composed of fibres, which, above, spring from the sub-peritoneal fascia, and follow the course of the vessels of the ovary, which are in great measure surrounded and covered by them. When they reach the broad ligaments, they spread over the posterior lamina, then pass along the posterior surface of the body of the uterus, to the pavilion of the tube, and to the hilum of the ovary, to be prolonged partly within the gland, and partly within the ala of the tube.

Structure of the Ovary.

Until lately, the ovary has been considered to be composed of an external serous envelope, of a fibrous envelope proper, a tunica albuginea, and of a spongy substance in which the ovules were developed.

Nearly at the same time Schrön (1862), and Sappey (1863), demonstrated that hitherto authors had been deceived, and that, 1st, the serous or peritoneal envelope only exists as an epithelial layer; 2d, that the fibrous envelope does not exist; 3d, that the spongy part contains neither ovules nor Graafian follicles.

When the ovary is cut perpendicularly to its surface, and completely through, we see that it is composed of two parts:

1st, A superficial part, white, firm, and of a homogeneous appearance.

2d, A central reddish part of a spongy consistency.

The superficial portion is the exclusive seat of the ovary-vesicles; the deep, or central, part consists of bundles of muscular and laminated fibres. The former is the glandular, or ovigenetic layer; the latter the vascular, or bulbous portion.

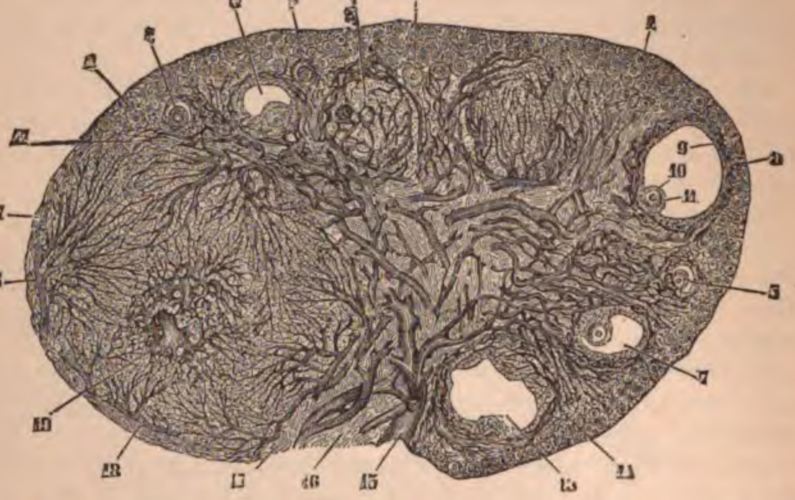


FIG. 29.—SECTION OF OVARY.—1, Cortical vesicles. 2, Larger vesicles. 3, Vesicles covered with granular membrane. 4, 5, 6, 7, 8, Follicles in various stages of development. 9, Granular membrane. 10, Ovule. 11, Cumulus proligerous. 12, A follicle that has not been opened, and which is covered with a vascular net-work. 13, A follicle, the contents of which have partly escaped. 14, Stroma of the cortical zone. 15, Vessels piercing the hilum of the gland. 16, Stroma of the hilum. 17, External membrane of a corpus luteum. 18, Artery of the same. 19, Its central vein (*Schrön.*)

I. *The Bulb of the Ovary.*

The bulbous portion forms the body of the gland. It supports the glandular, or ovigenetic part. It is more or less of a reddish color, depending upon the state of congestion of the bulb, and consists of muscular fibres, of fibres of connective tissue, and of vessels and nerves.

The muscular fibres, first described by Rouget in 1858, proceed from the ligament of the ovary, from the ligament of the tube, from the posterior round ligament, and from the posterior fold of the broad ligament. They pass from below upward, at the same time spreading out, and crossing each other.

The fibres of the connective tissue follow the entire course of the vessels. Mingled with them are a great number of fusiform fibro-plastic bodies.

The arteries spring from the utero-ovarian artery. All enter the bulb through the hilum, and are eminently flexuous and helical. They anastomose, and form a net-work, the meshes of which grow smaller as they approach the surface of the gland.

The veins are very numerous and very large. By their anastomosis they form a plexus, from which arise the capillaries. These become trunks, and empty into the utero-ovarian vein.

The very numerous lymphatics form eight or ten trunks, which pass from the hilum of the gland to the lumbar glands.

The nerves proceed from the ovarian plexus.

Rouget considered the bulb an erectile organ; but according to Sappey it can not be a true erectile organ, having only the appearances, without the real formation.

II. *The Ovigenetic Layer.*

This is the peripheral portion, the essential part of the ovary. It is 0.39 of an inch thick, and is smooth, even in young girls and young women. When the ovary is covered with cicatrices it becomes uneven. It is composed of an epithelial layer, of a fibrous layer, of fusiform fibro-plastic bodies, of vessels and nerves, and finally of ovarian vesicles, and the follicles of De Graaf. (See Figs. 58, 59, 60.)

1st. *Epithelium.*—It is formed by a single layer of ovoid, or rather prismatic cells, and covers the whole surface of the ovary, except at the hilum.

2d. *Fibrous Layer.*—This serves as a frame-work of support. It is composed of laminated fibres, studded with numerous fusiform fibro-plastic bodies (Robin). It adheres to the epithelium by its external surface, and is continuous with the laminated fibres of the bulb; there being no distinct line of demarcation. It is of a white color.

3d. *Vessels and Nerves.*—The blood-vessels are very numerous, and form, by their anastomoses, a thick net-work. The final arterial twigs spread over the circumference of the ovarian vesicles. The veins are continuous with those of the bulb. The nerves follow the course of the arteries.

III. *Ovarian Vesicles.*

These are the envelopes of the eggs, or ovules, the ovisacs of Barry. De Graaf, in 1672, was the first to carefully describe them, hence the name vesicles of De Graaf or Graafian follicles.

The Graafian follicles are all in the peripheral portion, and in a child of two years there are about 400,000, and still more in the fœtus. They increase, at the age of from 18 to 20 years, to about 350,000 per ovary, or nearly 700,000 for each woman. A woman therefore has, when in the fœtal condition, all the vesicles that she is to have later. They are not absolutely found only in the peripheral portion of the ovary, and if, after puberty, some seem to be found in the bulbous portion, this is caused by the development of some of them, which then extend beyond the ovigenetic layer, and penetrate the bulbous layer, becoming larger the deeper they go. (Fig. 30.)

From the moment of birth to puberty, the ovisacs and ovules scarcely change. They are spherical, having a diameter not exceeding $\frac{1}{850}$ of an inch. Their walls consist of connective tissue, which is thin yet resisting. They do not contain fluid, but are filled with epithelial cells, and with the ovule. At the moment of puberty, a number of these vesicles develop, acquire the volume of a millet seed, a piece of shot, or even a pea. One comes to complete maturity in from three weeks to a month, and bursts and allows the ovule to escape. This phenomenon is reproduced at each menstrual epoch; we will study it in detail further on. The ovisac, at this epoch of complete development, is composed of:

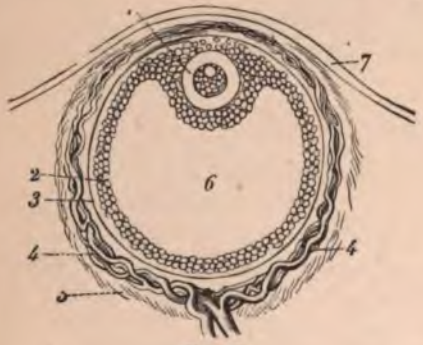


FIG. 30.

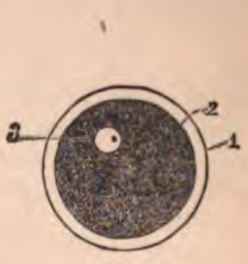


FIG. 31.

FIG. 30.—FOLLICLE OF DE GRAAF.—1, Ovum. 2. Membrana granulosa. 3, External membrane of Graafian follicle. 4, Its vessels. 5, Ovarian stroma. 6, Cavity of Graafian follicle. 7, External covering of ovary.

FIG. 31.—OVULE (*Kölliker*).—1, Zona pellucida. 2, External contour of the vitellus. 3, Germinal vesicle with the germinal spot (magnified 250.)

1st. A wall, or enveloping capsule, which has the appearances of reticulated tissue, and which becomes highly vascular. According to Robin, it is composed of laminated fibres piled one against the other, of a transparent amorphous material in fine granulations, and of voluminous polyhedral cells with rounded angles, which are found only in the wall of the ovisac, and in the uterine mucosa developed during pregnancy.

2d. A clear viscid liquid.

3d. A layer of small round cells with nuclei, which are next to the internal face of the enveloping capsule. This is the granular membrane (membrana granulosa). These cells are denser and more numerous at one point, and form by their union at this point the discus or cumulus proligerous. At the centre of this disc the ovule is found.

IV. *The Ovule.*

The ovule (Fig. 31) was discovered by de Baer in 1827. It is spherical in shape, and it is composed of three parts:

1st. An envelope or vitelline membrane. This is thick, elastic, resisting, transparent, of a homogeneous aspect, and an amorphous nature.

2d. A granular liquid, the vitellus. This is analogous to the yolk.

3d. A transparent vesicle, the germinal vesicle, the vesicle of Purkinje, who discovered it in birds. It was only discovered in 1834, in mammalians by Coste. It is spherical, extremely tenuous and transparent. It is formed by an amorphous membrane which encloses a liquid limpid as crystal. It is about $\frac{1}{120}$ of an inch in diameter.

In this vesicle, Wagner observed a peculiar corpuscle which he called the germinal spot.

V. *Embryogenetic Vesicle.*

In certain species of animals Balbiani has observed and described in the ovule a particular body, or special vesicle, which he called the embryogenetic vesicle. This is destined to form the plastic matter which aids the development of the new being. (Tarnier.)

THE UTERUS.

The uterus or womb, is the organ in which the fertilized ovule is developed, and which expels the fœtus when the term of pregnancy arrives. The uterus is a single median and symmetrical viscus.

Form, Position, and Size of the Uterus.

Form.—It is shaped, from before backwards, like a flattened cone with base upward. Immediately below its centre is a circular depression that divides the organ into two parts: the superior part is the larger—the body; the inferior part is narrower—the cervix. The depression which separates them is the isthmus of the uterus.

Position.—The uterus (Fig. 32) is placed in the cavity of the pelvis, between the rectum behind, the vagina below, to which it is firmly united, the bladder in front, and laterally, the broad ligaments which hold it.

In the fœtus its fundus is at the level of the fifth lumbar vertebra, then it seems to be forced down into the true pelvis from birth; but in the adult, the fundus of the uterus is on a level with the superior strait, and, in a majority of cases, it is seen to be on the level, or even below this strait.

Size.—The size of the uterus is extremely variable, depending not only on age, but on the time when it is examined.

Before puberty the cervix is almost as large as the body, but from that period on the body acquires a preponderance which it never loses, even in old women. Later, there are modifications in the size of the uterus, some temporary, others permanent.

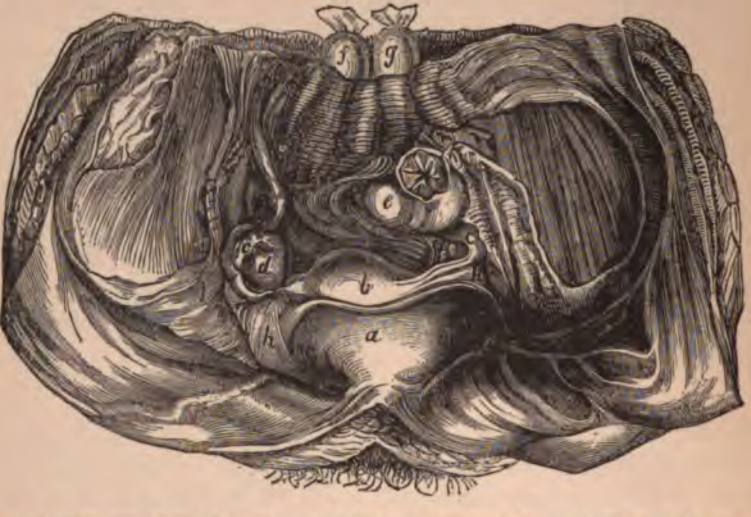


FIG. 32.—POSITION OF THE UTERUS.—*a*, Bladder. *b*, Fundus uteri. *cc*. Tubes. *dd*, Ovaries. *e*, Rectum, *f*, Aorta. *g*, Ascending vena cava. *hh*, Round ligaments.

Thus, menstruation increases very perceptibly and momentarily the size of the uterus, whereas the sexual relation and repeated pregnancy cause a permanent modification.

Richet gives the following dimensions:

Virgins	Vertical diameter of the cavity .	. 1.7 inches.
	Transverse diameter (intra-uterine)	. .5 "
Nulliparæ	Vertical diameter of the cavity .	. 2.0 "
	Transverse diameter (intra-uterine)	. 1.0 "
Multiparæ	Vertical diameter of the cavity .	. 2.3 "
	Transverse diameter (intra-uterine)	. 1.2 "

The following are the dimensions given by Sappey:

Virgins	Length of the uterus	. 2.3 inches.
	Width.	. 1.4 "
	Thickness	. .85 "

Nulliparæ	Length	2.4 inches.
	Width	1.5 "
	Thickness	.89 "
Multiparæ	Length	2.6 "
	Width	1.6 "
	Thickness	1.01 "

These measurements agree, as we will shortly see.

In nulliparæ the body is a little more than half of the total length.

In women who have had one or more children the body lengthens from .31 to .39 of an inch.

The average weight of the uterus is about 630 grains. For a short time it varies in weight from 22 to 24 ounces.

Direction.—According to ancient authors, the uterus follows the direction of the inferior strait, and the cervix is then directly under the body of the organ, its mobility allowing it to move as a whole forward, backward, and laterally. The names Ante-, Retro- and Latero-version have been given to these excesses in movements, which are considered pathological.

The cervix and fundus do not have an equal mobility. The cervix, being better placed than the body, can move forward, backward and even sideways. Of these movements, anteflexion appears so common that it might be considered a normal condition. Richet differs from this, showing that anteflexions are always accompanied by a morbid state of the organ. He gives us the following:

1st. In the fœtus and child, the uterus can have no exact and determined position. Situated in the abdomen, not in the pelvis, it is affected by any pressure without the least resistance, particularly that of the intestines, which are strong enough to move and hold it forward.

2d. In adults and nulliparæ the uterus is slightly curved forward, and its axis seems to follow the direction of the pelvic canal.

3d. Displacements are frequent, principally anteflexion and anteversion, which result from the pressure of the intestines.

4th. When the deviation of the uterus, version or flexion, is complete, it is accompanied by changes in the uterine tissue.

According to Sappey, the direction of the axis of the uterus is governed by the condition of the bladder. If the bladder is partly filled, its direction is from above downward and from before backward, and is parallel to the axis of the superior strait. If the bladder is empty, it bends forward, the uterus forming a right angle with the vagina. If the bladder is full, the fundus of the uterus is pushed backward toward the rectum, its axis inclining from above downward and from behind forward, approaching that of the vagina.

While Sappey agrees with Richet on the little influence due to the presence of the rectum, it is easily seen that it is far different with the bladder. For him it is this organ that, more than any other, influences the direction of the axis of the uterus, according to its state of plenitude or vacuity.

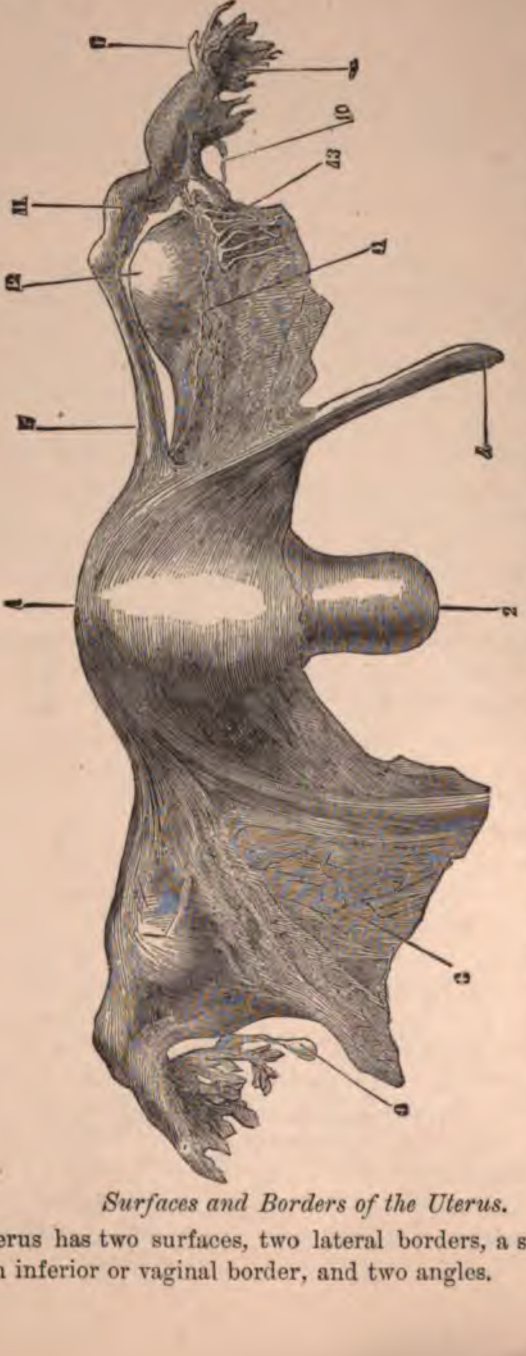


FIG. 33.—INTERNAL FEMALE GENITAL ORGANS,—ANTERIOR VIEW.—1, Fundus of the uterus. 2, Cervix uteri. 3, Broad ligament. 4, Round ligament. 5, Tube. 6, Pavilion of the tube. 7, Fringes of the pavilion of the tube. 9, Vesicle hanging from a fringe. 10, Ligament of the tube. 11, Broad ligament cut to show the ovary. 12, Ovary. 13, Organ of Rosenmüller or parovarium. (*Beaunis* and *Bouchard*).

Surfaces and Borders of the Uterus.

The uterus has two surfaces, two lateral borders, a superior or fundal border, an inferior or vaginal border, and two angles.

1st. *Anterior Surface.*—This is triangular, slightly convex, and touches the lower end and posterior surface of the bladder.

2d. *Posterior Surface.*—Is markedly convex, and presents on the median line a sort of crest, which passes over the superior edge to the insertion of the vagina.

3d. *Lateral Borders.*—The broad ligaments are inserted on these edges.

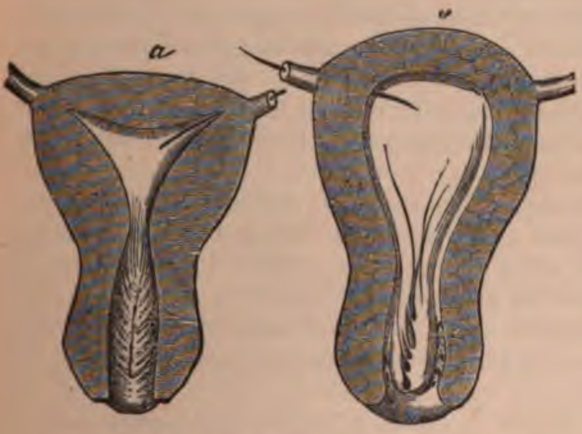
4th. *Superior Border.*—Smooth, rounded, thick, it is included between the insertions of the tubes.

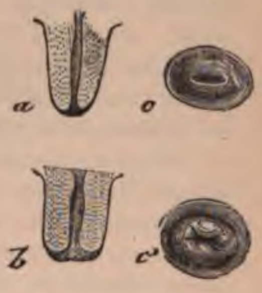
5th. *The Inferior Portion* is formed by the vaginal portion of the cervix.

The angles formed by the union of the superior edge with the lateral edges, are remarkable in that it is at this point that the tubes are attached. The round ligaments are in front of, and the ligament of the ovary is behind, these Fallopian tubes. (Fig. 33.)

I. *Body of the Uterus.*

The body is the part placed above the circular notch that separates the inferior part of the organ from the middle part. This notch is very prominent in the fœtus and nulliparæ, largely disappearing, exteriorly at least, in multiparæ.





FIGS 34, 35.—UTERUS OF NULLIPARÆ (*a*) AND MULTIPARÆ (*b*). (*Dubois* and *Pajot.*)

FIG. 36 TO 39.—DIFFERENCES IN THE CERVIX AND ITS ORIFICE IN MULTIPARÆ AND NULLIPARÆ. —*a* and *c*, Cervix of the nulliparæ. *b* and *c′*, Cervix in the multiparæ.

II. *Neck or Cervix of the Uterus.*

The neck must be described separately in nulliparæ and multiparæ.

In nulliparæ it is slightly flattened from before backward, is almost cylindrical, and bulges a little at its centre; its length is from 1.1 inch to 1.17 inches, its width from .6 to .9 of an inch at its centre, and about

.7 of an inch at its superior and inferior parts. Its thickness is almost equal to its width. The vagina, inserting at the union of the inferior with the middle part of the neck, divides it into two parts:

1st *Supra-vaginal Portion.*—This is about .7 of an inch in length, its anterior portion reaching the bladder. The peritoneum, after extending over the superior half of this anterior part of the neck, passes on to the bladder, forming the vesico-uterine cul-de-sac. Its inferior portion is closely united to the bladder, and it reaches the rectum at its superior part. The peritoneum holds it throughout its length, and passes from it to the rectum, forming the recto-uterine cul-de-sac.

Its edges reach the inferior part of the broad ligaments.

2d. *Infra-vaginal Portion, os tincæ.*—At the base of the vagina it projects about .29 of an inch, a little further behind than in front, and this is due to the greater height of the insertion of the vagina behind. This projection, shaped like a cone, has a transverse slit, of from .23 to .31 of an inch, at its apex, which divides it into two lips, one in front the other behind. The anterior lip of the os tincæ is a little thicker than the posterior. This slit is the orifice of the os tincæ (carp's mouth), and external orifice of the cervix.

In the multipara the supra-vaginal portion is little changed. The infra-vaginal portion, on the contrary, is essentially different from that of a nullipara. Instead of a conical shape, it is larger, in the form of a cylinder. The lips are uneven, wrinkled and furrowed by depressions which correspond to the lacerations caused by the passage of the fœtal head at delivery. They are principally seen on the left, in consequence of the great frequency of the left occipito-anterior positions. The orifice is distorted, enlarged and open.

The os tincæ may, in some women, be so shrivelled, that one can scarcely find it per vaginam, and then it feels hard and irregular, with a little opening that tells where the cervix is. These deformities are in proportion to the number of pregnancies. Tarnier is said to have seen three women in whom the cervix kept the nulliparous shape. The women had had but one child. These cases therefore are entirely exceptional.

II. *Internal Surface of the Uterus.*

The cavity of the uterus is shaped like a canal, flattened from before backwards, larger in the body than in the cervix, which is narrow, with a kind of contraction at the isthmus.

In nulliparæ this cavity is 2.1 inches according to Richet, 2.02 according to Sappey. In parous women 2.3 inches according to Richet, 2.2 inches according to Sappey. This last author divides them thus:

Nulliparæ.—Cavity of the body 1.05 inches; cavity of the cervix 1.05 inches; intermediate canal .19 inches. Multiparæ.—Cavity of the body

1.05 inches; cavity of the cervix .69 inches; intermediate canal .19 inches. The cavity of the body is triangular, having two surfaces, two borders and three angles. The surfaces are planes placed one on the other. The borders, in nulliparæ, are convex, the superior reaching the others by the tubes. The lateral run from the mouth of the tube to the internal orifice. (See Fig. 34 and following.)

The angles are: two superior, forming a funnel-shaped canal at the top of which the tube opens; an inferior, which extends to the isthmus, or intermediate part of the uterine cavity.

In multiparæ the cavity of the body remains triangular, but the borders become rectilinear.

The walls are a little thicker at the fundus, where they are .39 of an inch; at the mouth of the tube they are but .31 inches. On the surfaces and lateral borders, on the contrary, the thickness is .46 inches.

The cavity of the cervix is shaped like a canal, distended in the middle, and flattened in front and behind, having two walls, two borders and two orifices.

The walls have a longitudinal projection, whence, running to the right and to the left, are secondary projections, ascending and oblique. This is the arbor vitæ. These two anterior and posterior projections are not similar. Their juncture is much more pronounced at the upper portion. The edge of the cavity describes a curve the concavity of which is not directly inward, but inward and slightly downward. (See Fig. 34 and following.)

The internal orifice is from .19 to .23 inches in length. It forms a sort of strait by which the cavities of the body and neck intercommunicate. The markings of the arbor vitæ are prolonged to its superior portion. After the menopause the internal os gradually contracts and can even disappear entirely.

Relations of the Uterus.

The uterus is situated in the median line, between the rectum and the bladder, but slightly inclined to the right, its position corresponding to the curve of the pelvic canal. (Fig. 40). Its base is turned upward and forward when the woman is standing, the bladder very slightly distended, and when the intestines are not too greatly depressed. When, on the contrary, the bladder is distended, or the woman is lying down, the body of the uterus is pushed backward, and rests on the rectum. In these different positions the cervix varies but little, and is placed behind and below, in such a way that the os tincæ rests on the posterior wall of the vagina, the anterior lip forward, the posterior lip backward.

The fundus never passes below the superior strait, often scarcely reaching that.

The anterior surface is in contact, superiorly, with the peritoneum which covers it, with the intestine and the bladder, from which it is separated by the vesico-uterine cul-de-sac. Inferiorly it is not covered by the peritoneum, and is closely connected with the bladder and vagina, the vaginal walls being inserted lower in front than behind.

In parous women the vaginal mucosa has always sagged somewhat; from this it follows that all that part of the anterior face of the uterus which is between the reflection of the vaginal mucosa on the cervix, and that of the peritoneum on this anterior surface, is closely connected with the posterior surface of the bladder. This space is about 1.1 inches long, and throughout its length, the union of the bladder with the superior

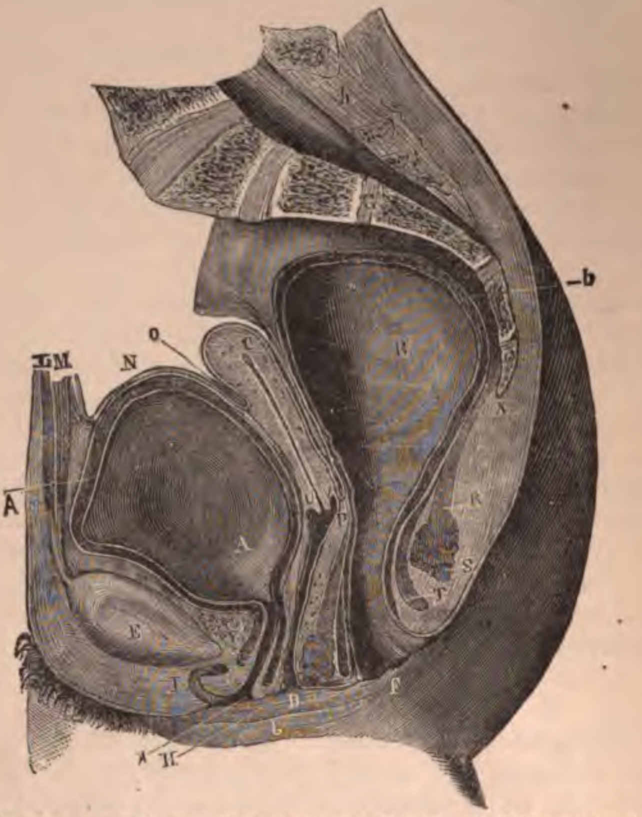


FIG. 40.—SECTION OF THE PELVIS. RELATIONS OF THE UTERUS. (*E. Q. Legendre*).—*A*. Bladder. *B*, Rectum, distended by fecal matter. *C*, Body of the uterus. *D*, Opening of the vagina. *E*, Pubic symphysis. *F*, Anus. *G*, Sacrum. *H*, Right labium minus. *I*, Clitoris, section of root of corpus cavernosum. *J*, Right labium majus. *K*, Meatus of the urethra. *L*, Pyramidalis muscle. *M*, Rectus abdominalis. *N*, Peritoneum. *Q*, Utero vesical cul-de-sac. *P*, Recto-uterine cul-de-sac. *R*, Levator ani. *S*, External sphincter ani. *T*, Internal sphincter. *U*, Anterior lip of the neck of the uterus. *V*, Posterior lip. *X*, Coccyx. *Y*, Venous plexus of Santorini. *Z*, Venous plexus vaginæ. *a*, Muscular coat of the bladder and urethra. *b*, Muscular coat of the rectum. *c*, Fifth lumbar vertebra. *p*, Spinal canal.

wall of the vagina, and the corresponding part of the body and neck of the uterus, is made by cellular tissue, easily broken or torn off with the finger.

The posterior surface of the uterus is connected with the peritoneum, which covers its two superior thirds, below with the vaginal walls, which are a little higher than in front, and with the rectum. The uterine cul-de-sac is there formed by the peritoneum. The edges are connected with the broad ligaments.

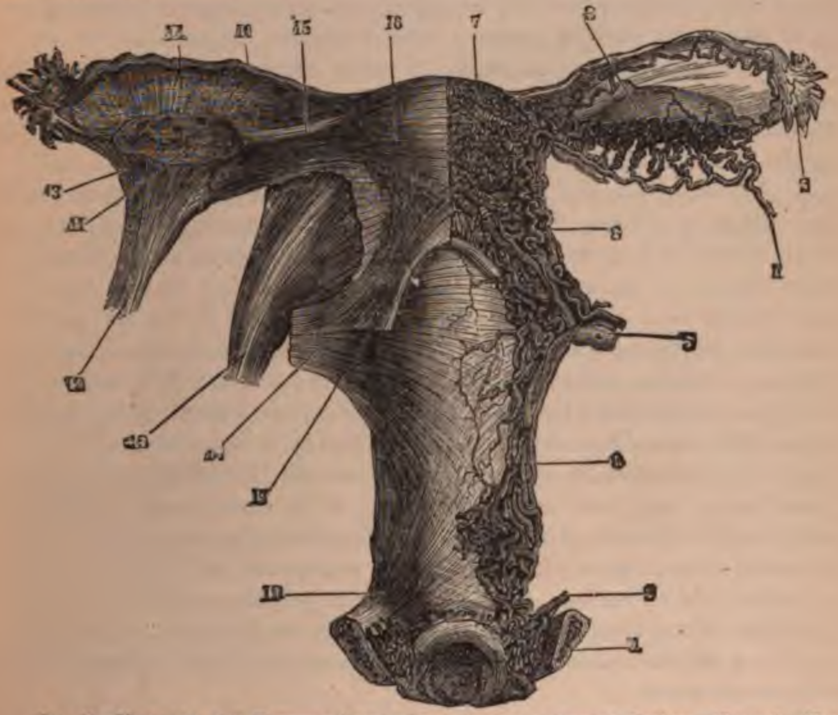


FIG. 41.—MUSCULAR AND ERECTILE COATS OF THE INTERNAL GENITAL ORGANS. (*Rouget*).—The vascular coat is shown on one side; the muscular on the other. 1, Pubis. 2, Pavilion of the tube. 3, Ovary. 4, Ovarian artery. 5, Uterine arteries and veins. 6, Uterine plexus. 7, Plexus or spongy body of the uterus. 8, Vaginal plexus. 9, Vaginal veins. 10, Tube. 11, Ovary. 12, Superior or lumbar round ligament which covers the ovarian vessels. 13, Its vessels entering the fringe of the ovary. 14, Its vessels prolonged to the tube. 15, Free fibres of the ovarian ligament. 16, Superficial muscular fibres of the uterus. 17, Recto-uterine fascia. 18, The fascia reaching the sacrum. 19, The fascia at the pubes. 20, Round pubic ligament (the posterior surface of the organs is shown.)

Structure of the Uterus.

The uterus consists of three coats: an external, serous or peritoneal, a middle or muscular tissue, an internal or mucous.

1st. *External or Peritoneal Coat.*—In studying the relations of the uterus, we saw the position of the peritoneum on the anterior and posterior surfaces. The peritoneum adheres much more strongly to the fun-

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dus than to the cervix, and lateral borders; it is folded forward and backward to form the vesico-uterine cul-de-sac in front, and the recto-uterine behind, and the two layers are placed back to back, as soon as they leave the border of the uterus to form the broad ligaments which will be described later. (Fig. 33.)

2d. *Muscular Coat.*—This is formed of a muscular tissue so thick and compact that, when empty, it appears more like a fibrous tissue than a muscular one. It is only when pregnancy has excessively enlarged all its fibres that their position and arrangement can be observed. Their muscular nature can then be proved. (See Article on Pregnancy.)

3rd. *Internal Coat.*—Although, in olden times, the existence of this coat was a subject of dispute, the researches of Coste and Robin have established it beyond a doubt. It is a mucosa, having a different character in the body and in the cervix.

a. *Mucosa of the Body.*—This is whitish and rosy; according to Coste and Robin it is from .23 to .31 inches thick, according to Sappey only from .039 to .078 inches. As it approaches the superior angles its thickness lessens; at the opening of the tubes it is scarcely .018 inches. It also lessens near the internal os, but not so much. It has no papillæ, and the only thing noticeable is a multitude of orifices which are the openings of as many small glands. It is closely connected with the muscular coat. It consists of a layer of cylindrical epithelium, with vibratile cilia, which move from without inward; this layer is shallow. The deep layer, a true mucosa, is underneath, and consists (Robin) of a connective tissue in the embryonic condition, that is, of an embryo-plastic nucleus, and fusiform bodies, of some fibrous laminated tissues, of special cells identical with those of the ovisac, of an amorphous material, of glands, of vessels and of nerves. The glands are in rectilinear or slightly flexuous tubes of a cylindrical shape. They are generally simple. According to the recent researches of de Sinety their secretion does not have a true mucous character.

b. *Mucosa of the Cervix.*—It is whiter, firmer, and not so thick.

The epithelial layer in the two superior thirds, consists of a cylindrical and vibratile epithelium pavement near the external orifice. The rest of the cervix is covered by an epithelium formed of calciform cells; these produce the mucus.

The deep layer consists of a fibrous connective tissue, in which a very few round cells can be found.

The mucosa of the cervix has very small papillæ, which are only on the inferior half, and are completely covered by the epithelium.

The glands are in a cluster. They extend to the muscular layer, are covered by calciform cells, and end in a single tube, which opens at the bottom of the grooves, which separate the markings of the arbor vitæ.

They often disappear, enlarging according to the accumulation of mucus, and forming little cysts, which are called the glandulæ nabothi. Naboth considered them as ovules, which had fallen from the body into the cavity of the cervix.

At the periphery of the os tincæ the mucosa is smooth and red; it is prolonged, and blends with that of the vagina.

VESSELS AND NERVES OF THE UTERUS (FIGS. 41 AND 42).

I. *Arteries.*

The uterus is supplied by six arteries:

The uterine arteries, branches of the hypogastric;

The utero-ovarian arteries, which come directly from the aorta;

The two arteries which are in the round ligament, and which arise from the epigastric arteries.

Three of these arteries enter at the right border, three at the left. The arteries on each side intercommunicate to a large extent. Whether superficial or deep they are all flexuous, and are so, not only during the state of vacuity, but also during pregnancy.

II. *Veins.*

They are very much expanded, and follow the course of the arteries, adhering by a thick cellular tissue to the muscular layer of the organ. During pregnancy they reach an enormous size, and are called sinuses.

Some follow the utero-ovarian arteries, and form the veins of the same name; their right terminal branches empty into the inferior vena cava, their left into the left renal vein.

Others, the uterine veins, belong, like the arteries, to the inferior part of the body of the uterus, and to the cervix; their terminal branches empty into the hypogastric plexus.

Finally, those which are deep in the round ligament, empty into the epigastric veins, or the external iliac veins.

III. *Lymphatics.*

The study of these vessels was undertaken in 1873 by Leopold, who divides them into three layers.

1st. A sub-serous layer;

2d. A layer belonging to the muscular coat;

3d. A mucous layer.

Directly below the serous, the sub-serous lymphatics form a thick network, composed of short and ampulliform vessels which make a kind of plexus that surrounds the uterus. At the insertion of the tubes this network passes above these organs, binding them to their abdominal end, and to the uterine insertion of the broad ligaments.

In places, these lymphatics abruptly turn into the muscular tissue to unite with the lymphatics of this tissue.

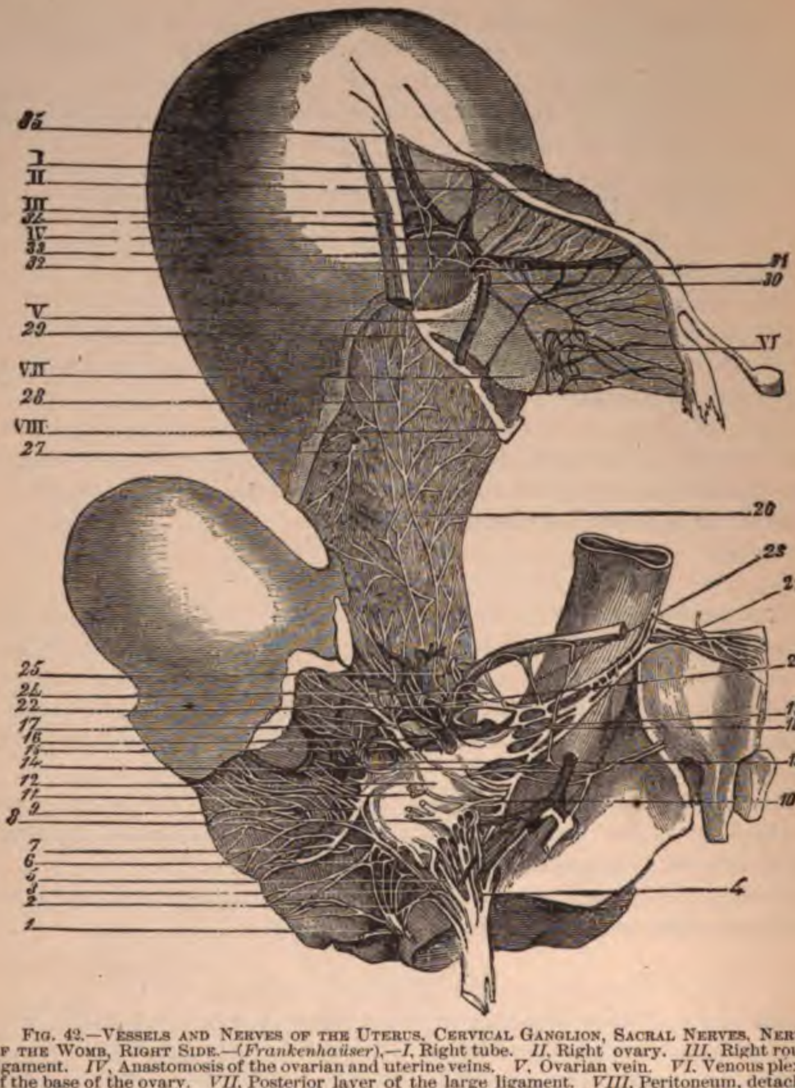


FIG. 42.—VESSELS AND NERVES OF THE UTERUS, CERVICAL GANGLION, SACRAL NERVES, NERVES OF THE WOMB, RIGHT SIDE.—(*Frankenhaüser*).—*I*, Right tube. *II*, Right ovary. *III*, Right round ligament. *IV*, Anastomosis of the ovarian and uterine veins. *V*, Ovarian vein. *VI*, Venous plexus of the base of the ovary. *VII*, Posterior layer of the large ligament. *VIII*, Peritoneum, detached and turned back. 1, Hemorrhoidal nerve. 2, Nerves arising from the fourth sacral foramen and going to cervical ganglion. 3, Nerve leaving the third sacral nerve, and passing above the cervical ganglion, to go directly to the bladder and vagina. 4, Nerve going from the second sacral nerve to the cervical ganglion (not constant). 5, more important nerve from the third sacral nerve going to the cervical ganglion. 6, Small nerve coming from the cervical ganglion and ramifying with the hemorrhoid plexus. 7, Nerves distributed between the vagina and rectum. 8, Small ganglion placed above the cervical ganglion, whose filaments proceed directly to the bladder. 9, Nerves of the vagina. 10, the more external branch of the hypogastric plexus connecting with the cervical ganglion. 11, Arteries and veins crossing the centre of the cervical ganglion. 12, Cervical ganglion. 13, Branches passing between the vagina and the bladder. 14, Nerves going from the first sacral ganglion of the terminal ramification to the urethra. 15, 17, Anastomotic branches going to the cervical ganglion. 16, Nerve entering deep into the cervix. 18, 19, Anastomotic branches between the cervical ganglion (21) and the most external ramification of the hypogastric plexus. 20, Cervical ganglion. 22, Branches of the vesical ganglion, partly entering deep into uterine tissue, partly uniting with the most internal branch of the hypogastric. 23, 24, Nerves proceeding from the hypogastric plexus to the urethra. 25, 26, 27, 28. The most superficial ramifications of the nerves which go to the womb from the hypogastric plexus and cervical ganglion. 29, Anastomotic branch between the uterine and cervical nerves. 30, Entering of the ovarian nerves through the posterior border. 31, 32, Anastomoses of the uterine and ovarian nerves, often indicated by a kind of ganglion, branches which in separating (34) go one to the round ligament, the other (35) to the fundus of the womb. 33, Nerves going to the tube (a little too clearly shown).

These last lymphatics of the muscular tissue consist of three kinds of vessels.

1st. A system of lymphatic tubes which lead directly to the sub-serous lymphatics and are situated between the large muscular fascia.

2d. Of fine lymphatic lacunæ, placed between the muscular fibrils, which all open into larger ducts.

3d. These represent large anastomoses, which form a net-work placed between the layers of the muscular tissue, and spread into the broad ligaments.

The lymphatics of the mucosa are not true vessels; they are formed of an enormous system of vacuoles, and lymphatic cavities, communicating with each other; in other words the mucous membrane is an enormous lymph gland. These lymphatic vacuoles communicate with the lymphatics of the muscular tissue by means of a number of trunks which, coming from the muscular coat, open into the bottom of the lymphatic vacuoles of the mucosa. Lucas Championière discovered a ganglion above the vaginal cul-de-sac at the union of the cervix and the body. According to him it plays an important part in the development of puerperal diseases.

IV. *The Nerves of the Uterus.*

The nerves of the uterus arise from the ovarian, and from the hypogastric plexus. At first they follow the arteries, then penetrate the muscular coat, for which they seem to be specially designed. Frankenhauser (1867) demonstrated that, in the state of vacuity, the nerves in the broad ligament are divided into two kinds, one of which has the form of complete tubes, the other that of a thread reduced to an axis cylinder. According to Frankenhauser, the terminal filaments can not only pass into the nucleus, but even into the nucleolus of the fibrous cells.

Their presence has been contested by Jobert (de Lamballe), but the researches of Robert Lee, of Richet, of Boullard, of Sappey, and of Frankenhauser are opposed to this assertion of Jobert.

LIGAMENTS OF THE UTERUS.

The uterus is held in the pelvis by eight ligaments: Laterally the broad ligaments; antero-laterally, the round ligaments; posteriorly, the utero-sacral ligaments; anteriorly, the vesico-uterine ligaments.

I. *The Vesico-uterine Ligaments.*

These are of so little importance that Sappey scarcely describes them. They are formed by a fold of peritoneum where it passes from the uterus to the bladder. A few muscular fibres, going from the uterus to the bladder, and holding these folds of the peritoneum to the lateral portions, constitute these ligaments.

II. *The Utero-sacral Ligaments.*

These are much larger than the preceding, but like them are formed by muscular fibres, which leave the posterior surface of the uterus, while holding the peritoneum at the point where it is reflected from the posterior surface of the uterus, to the anterior surface of the rectum. Laterally, they embrace this organ, and are inserted on the lateral and anterior portions of the third and fourth sacral vertebræ. Some of the fibres are lost directly in the walls of the rectum.

III. *The Round Ligaments.*

They leave the superior and anterior part of the uterus below the tube; then occupy the anterior fold of the broad ligaments, whence they pass towards the abdominal orifice of the inguinal canal, and are terminated by fibres, some of which are attached to the inferior wall of the inguinal canal, others to the spine of the pubes, and others still, passing out of the external inguinal ring, are lost in the labia majora.

They consist of a peritoneal envelope, striated muscular fibres, and smooth muscular fibres, an artery, veins, fibres of elastic tissue, and fibres of connective tissue.

The peritoneal envelope, after having covered their anterior portion, furnishes them a complete envelope, which leaves them at the superior orifice of the inguinal canal, to form, at this point, a depression called the external inguinal ring. The terminal parts of the round ligaments are, in the adult, unprovided with peritoneum.

In the fœtus, on the contrary, the peritoneum accompanies the round ligaments to their extremity, and thus penetrates with them the inguinal canal, and forms a diverticulum called Nuck's canal. The smooth fibres proceed directly from the uterus; the striated fibres are furnished, according to Rouget, by the transversalis abdominis.

The artery of the round ligament sometimes comes directly from the epigastric, more frequently from the cremasteric artery. It occupies the centre of the round ligament, and is prolonged to the uterus, for which it is principally designed.

Several veins accompany this artery. All communicate, and form a plexus, very marked even in the fœtus. During pregnancy they develope considerably, and in certain cases may even become varicose.

The nerves emanate from the genital branch of the genito-crural nerve.

The function of the round ligaments is to bring the womb forward after emptying of the bladder (Sappey). We will see, further on, that Thevenot makes them play an important part in the accommodation of the fœtus.

IV. *Broad Ligaments.*

Placed vertically in the pelvic cavity, the broad ligaments are the principal ligaments of the uterus, the lateral borders of which they clasp by their internal extremity, while they are attached to the wall of the pelvis by their external extremity. They are quadrilateral in shape, having four sides; a superior free end floating in the pelvis, an inferior facing the side of the perineum, and two lateral, one of which is attached to the uterus, the other to the wall of the pelvis. They divide the true pelvis into two cavities, one, the anterior, designed for the bladder, the other, the posterior, for the rectum. They therefore present for consideration an anterior surface, a posterior surface, and four borders. (Figs. 32 and 33.)

The anterior surface touches the bladder.

The posterior is in contact with the rectum, the convolutions of the ilium, and often of the sigmoid flexure.

Borders—1st. The superior border. It is free in the cavity of the pelvis, and is subdivided into three folds, the highest and middle one of which confines the tube, the anterior the round ligament, and the posterior the ovary.

2d. The external lateral border of the broad ligament touches the iliac fascia.

3d. The internal lateral border is attached to the lateral border of the uterus. To speak more correctly, the uterus is held between these ligaments, which separate to receive it. (See Fig. 44.)

4th. The inferior border of this ligament is divided into two laminæ, one of which passes forward, the other backward, and blends with the peritoneum of the floor of the pelvis.

The broad ligaments consist of cellular tissue, muscular fibres, Rosenmüller's organ, vessels, nerves, and connective tissue.

The cellular tissue is in large meshes, and becomes more abundant near the base. There it communicates with that of the sides of the vagina and rectum, also, through the sub-peritoneal layer of the pelvic walls, with that of the internal iliac fossa. In front and behind it is continuous with the peri-rectal and peri-vesical cellular layers. Finally, behind, at the sciatic notch, it corresponds to the deep cellular tissue of the gluteal region. This layer is interspersed with fibres of connective tissue having some elasticity.

The muscular fibres form two extremely thin layers with smooth fibres, which cross in all directions, forming a transverse net-work. The anterior layer unites to form the round ligament, and its most internal fibres are continuous with the superficial fibres of the uterus on its anterior surface. The posterior layer is continuous with the superficial fibres of the posterior surface of the uterus. These fibres pass outward, and are attached to the sacro-iliac synchondrosis.

Rosenmüller's organ (Fig. 43,) the parovarium of the Germans, is composed of fifteen or eighteen very fine tubes, which end in culs-de-sac pointing toward the hilum of the ovary. Situated in the middle layer of the broad ligament, between the ovary and the tube, they represent the vestiges of Wolf's body. All these pass upward towards the tube, and empty into a canal parallel to that tube. These small tubes sometimes become the origin of a cluster of small serous cysts.

Vessels—The arteries are branches of the uterine and utero-ovarian arteries. The veins proceed from the superior part of the vagina, from the cervix and body of the uterus, from the round ligaments, from the tube, from the ovary, and from a large plexus, called by Richet the utero-ovarian plexus. Having few valves, they are often dilated and varicose. They form a true varicocele, which may become the source of peri-uterine hematocele, in consequence of the rupture of some varicosities under the influence of intense congestion.

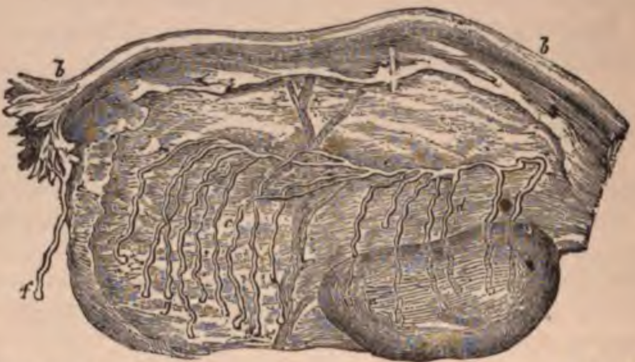


Fig. 43. ROSENMULLER'S ORGAN (*after E. Follin.*) *a*, Ovary. *b*, Tube. *cd*, Canals of Rosenmüller's organ. *e*, Common canal. *f*, Vesicle attached to the tube. *g*, Culs-de-sac of the canals of the organ.

The lymphatics come from the uterus and its appendages, and pass into the lumbar and iliac glands.

The nerves are branches of the hypogastric plexus and of the ovarian plexus.

Functions of the Broad Ligaments.

They support the uterus, are opposed to lateral deviations, and prevent, according to Richet, flexion of the body upon the neck. During pregnancy they aid, through the separation of their fibres, the developement of the uterus; thus, at the end of pregnancy they are almost completely effaced.

Pajot describes the following properties of the uterus in the condition of vacuity:

1st, extensibility; 2d, contractility; 3d, organic contractility; and, finally, marked faculty of reaction upon the cerebro-spinal system. We will see that these properties are considerably developed during pregnancy.

THE TUBES OR OVIDUCTS.

The uterine tubes, Fallopian tubes or oviducts, are two tubes which bring the semen into contact with the ovule, and conduct the ovule into the interior of the womb. (Fig. 44.)

They are situated at the sides of the uterus, to the superior angle of which they are attached, and occupy the free edge of the middle wing of the broad ligament.

They are straight near their origin, at the uterus, but at the end they bend and form, with their external half, a curve, the concavity of which faces backward, inward and downward. They terminate in an enlargement, turned towards the ovary.

Their length does not generally exceed 4.6 inches. Their diameter increases from the uterus toward the ovary. Near the uterus it is .15 inches, in its middle about .23 inches, and at the external or abdominal opening it reaches about .31 inches.

Shape.—Fallope compared them to a trumpet. They have, therefore, a tubular part, the body of the tube, and a wide part, the pavilion of the tube.

The body of the tube is continuous at its internal extremity with the superior angle of the uterus. It is in connection with the convolutions of the ilium, with the bladder and the ovary.

The tube opens into the cavity of the uterus by its internal or uterine orifice. This is situated at the bottom of the infundibulæ, which form the superior angles of the uterine cavity. Its diameter is .039 inches. The external or abdominal opening is at the top of the funnel-shaped pavilion. Throughout its whole length we find on the walls longitudinal folds which do not disappear on insufflation.

The pavilion, the wide part of the tube, is attached, laterally, to the lateral walls of the cavity, in which it somewhat freely floats. Its diameter is generally from .7 to .78 of an inch. It has an external surface, an internal surface, and a circumference.

External Surface.—It is continuous with the body of the tube; is covered by peritoneum, and is smooth and even.

Internal Surface.—This is concave and faces backward, downward, and inward, towards the ovary. The abdominal orifice is situated in its centre. A number of folds, which are continuations of the longitudinal folds of the body, leave the orifice of the pavilion and radiate towards its circumference. This circumference is not circular, but is cut into bands, called fringes. One of these, longer than the others, extends to the external extremity of the ovary, and forms the ligament of the tube.

G. Richard notes on the external third of the tube the presence of accessory pavilions, which occur only once in six. Sappey believes them to be much less frequent.

Structure.—The tube has three coats: an external serous; a middle muscular; and an internal mucous.

The external or peritoneal coat only envelopes three quarters of the circumference of the tube. It terminates on the free edge of the fringes, when it reaches the pavilion.

The muscular layer consists of two layers of fibres. An external, composed of longitudinal fibres, which, according to Sappey, are formed by a prolongation of the fibres of the uterus, but which are, according to Robin, entirely distinct. A deep layer composed of circular fibres, beginning at the abdominal orifice, where it forms a sort of sphincter, it continues to the uterus where it disappears. The uterine portion of the oviduct is represented only by the mucous coat.

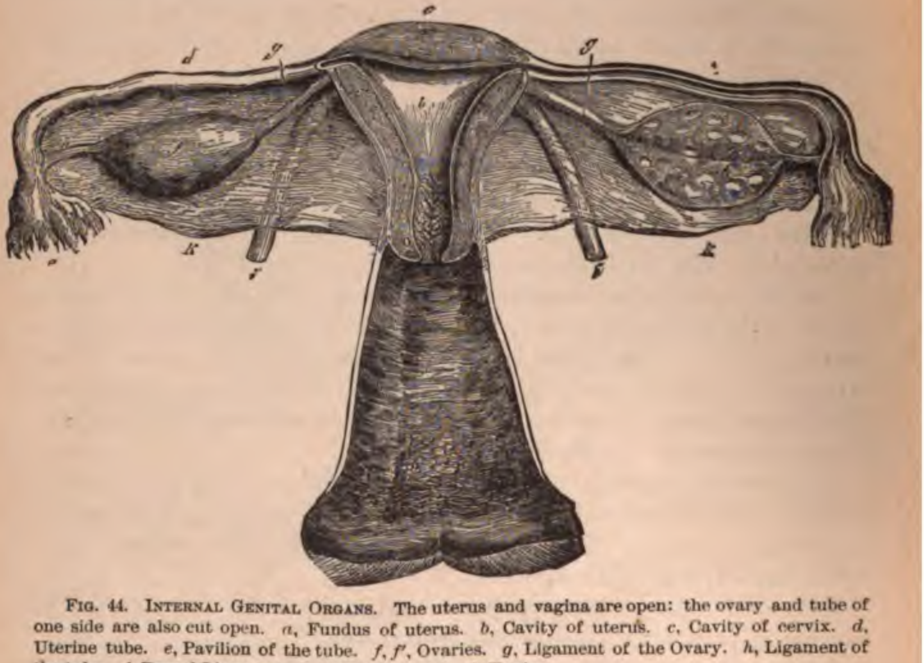


FIG. 44. INTERNAL GENITAL ORGANS. The uterus and vagina are open: the ovary and tube of one side are also cut open. *a*, Fundus of uterus. *b*, Cavity of uterus. *c*, Cavity of cervix. *d*, Uterine tube. *e*, Pavilion of the tube. *f*, *f'*, Ovaries. *g*, Ligament of the Ovary. *h*, Ligament of the tube. *i*, Round Ligament *k*, Broad ligament. *l*, Vagina.

The mucous coat has numerous folds. It is continuous at the internal extremity with the uterine mucosa; at its external extremity it extends to the base of the pavilion, *i.e.*, to the peritoneal envelope. The mucosa of the tube is covered with cylindrical epithelium with vibratile cilia; the peritoneum with pavement epithelium.

The vibratile ciliæ point from the ovary towards the uterus. Their function is to conduct the ovule to the womb, after it has been seized by the pavilion of the tube.

Vessels and Nerves.—The arteries come from the utero-ovarian artery.

The veins terminate in the utero-ovarian vein.

The lymphatics join those of the uterus and ovary and empty into the lumbar glands.

The nerves are very numerous and come from the utero-ovarian plexus.

THE VAGINA.

The vagina is a musculo-membranous canal passing from the vulva to the uterus.

It is situated in the pelvic cavity above the rectum and below the bladder and the urethra.

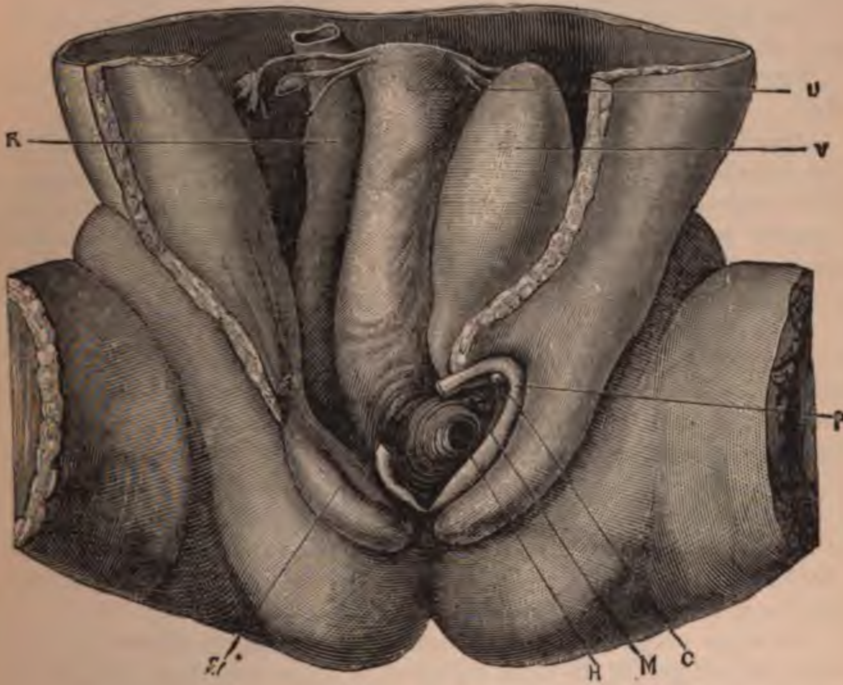


FIG. 45.—HYMEN. ITS RELATIONS TO THE VAGINA. *R*, Rectum. *U*, Uterus. *V*, Bladder. *C*, Clitoris. *p*, Labia minora. *gl*, Labia majora. *M*, Urinary meatus. *H*, Vaginal or hymeneal foramen. (*Budin*).

Its direction is oblique from above downward, and from behind forward. According as the bladder is full or empty, it forms, with the uterus, an obtuse angle with an anterior concavity, or a right angle.

The two walls are of unequal length. The anterior wall is from 3.1 to 3.2 inches long, the posterior from 3.2 to 3.9 inches. (Sappey.) According to Pajot the axial length of the vagina is 4.6 inches, according to Cazeaux from 4.2 to 5 inches. This length is not absolutely fixed, and in negresses in particular the vagina is usually longer than in Europeans. In some women, on the contrary, the vagina is short, being only from 1.5 to 1.9 inches long. Its calibre varies in different parts. Its narrowest point is where it joins the vulva; just behind this point the vagina begins to dilate, and continues to increase from below upward. Nevertheless, we may say that the average transverse and antero-posterior dimensions are from 1.1 to 1.5 inches in women who have had no children, and from 2.3 to 2.6 inches in others. The walls are besides very extensible, even reaching the sides of the pelvis when the head of the child passes. Pajot rightly observed that this extensibility is transverse, and that it does not permit nearly so great an increase in the longitudinal direction.

The vagina presents for consideration, an internal surface, a superior and an inferior extremity, and an external surface.

External Surface.—This has an anterior, a posterior and two lateral walls.

Anterior Wall.—It is shorter than the posterior wall, and above it lies the inferior wall of the bladder, and of the urethra. A thin cellular-tissue unites it to the lower end of the bladder; it also lies under the terminal portion of the ureters. For the remainder of its course the anterior wall lies below the canal of the urethra, which is united to it by muscular fibres. It even seems to form a groove to hold the canal.

Posterior Wall.—Behind, it is covered by the peritoneum for a distance not exceeding .46 to .58 inches. Below the recto-vaginal cul-de-sac the rectum adheres to it by cellular tissue. This junction of the rectum and vagina forms the recto-vaginal fold. Slender above, this partition gradually becomes thicker on account of the increase of the cellulo-fatty layer, and the distance apart of the two organs. The vagina is separated from the rectum below by a space of 1.1 to 1.5 inches. This space forms a triangle, the apex of which is the point of juncture of the rectum and vagina, and the sides of which are formed by the opposite walls of the rectum and vagina.

The edges or lateral walls correspond, from above downward, to the most inclined part of the broad ligament, to the adipose tissue of the floor of the cavity, to the superior pelvic aponeurosis, and to the levator ani. Below, these edges are covered by the bulbs of the vagina.

The internal surface is broken, along the median line, by two projections which form the columns of the vagina. They extend throughout its whole length. There are also transverse folds which are more marked in the anterior part of the vagina.

The superior or uterine extremity is attached to the neck of the uterus. The posterior wall being inserted higher than the anterior, the mucous membrane of the vagina, in folding about the neck, forms a cul-de-sac which may be divided into two, a posterior and an anterior cul-de-sac.

The anterior opening of the vagina is continuous with the posterior circumference of the vulva. It forms an oval orifice. When partially open it presents, on its superior part, a rough and round tubercle, the anterior tubercle of the vagina, and above this tubercle the orifice of the urethra.

Below, the vagina forms a depression, which separates it from the perinæum, and which is called the fossa navicularis.

In virgins this foramen is hidden by a membrane, called the hymen.

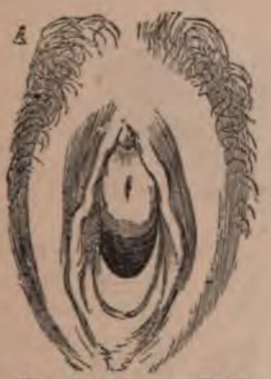


FIG. 46.—SEMI-LUNAR HYMEN.

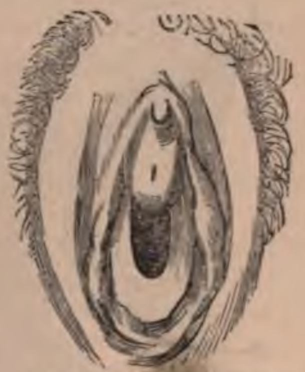


FIG. 47.—HORSE-SHOE HYMEN.

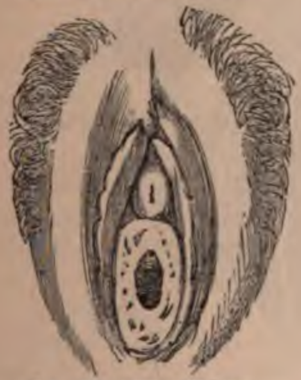


FIG. 48.—ANNULAR HYMEN.

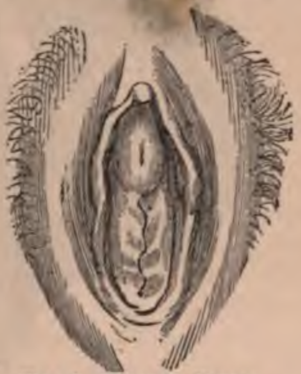


FIG. 49.—BILOBATE HYMEN.

The study of this membrane, considered by Sappey and Kölliker as a fold of the vaginal mucosa, and by Tarnier and Courty as the result of the union of the vaginal and vulvar mucous membranes, was finally taken up by Budin. According to him the vagina represents a glove finger which is terminated at its anterior extremity by a circular orifice. It is this perforated extremity of the glove finger which is insinuated between the labia minora, forming what is called the hymen. The hymen, as a true, special, distinct, and independent membrane does not exist. The vaginal orifice is nothing but the hymeneal foramen. This anatomical arrangement explains certain difficulties in the first sexual intercourse, the retardation which the head meets with in its expulsion in certain primiparæ, and, finally, the change in aspect of the vaginal orifice and the formation of myrtiform caruncles, after the first confinement.

Structure of the Vagina.—The walls of the vagina consist of: an external cellular-fibrous coat, a middle muscular layer, an internal or mucous coat, and vessels and nerves.

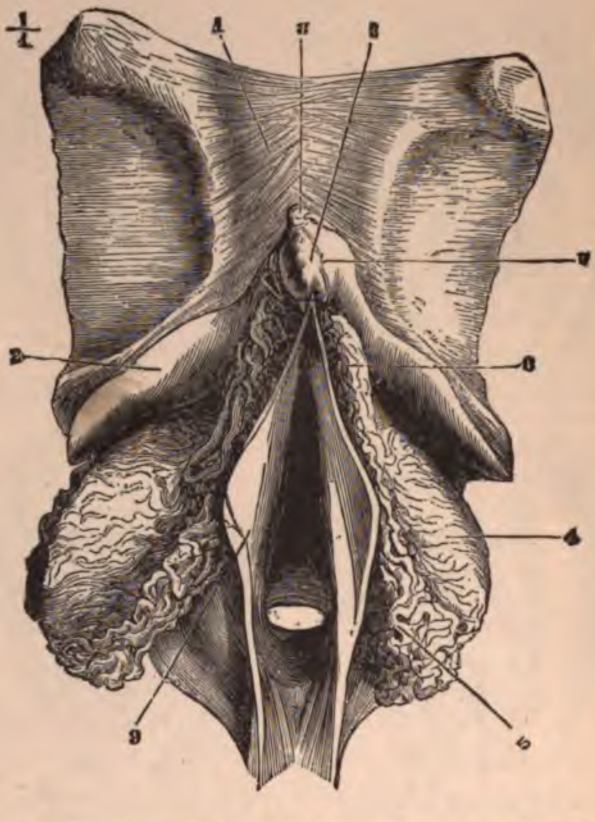


FIG. 50.—ERECTILE ORGANS.—1, Pubic symphysis. 2, Roots of the clitoris. 3, Clitoris. 4, Bulb of the vagina. 5.Veins. 6, Superior extremity of the bulb turning towards the clitoris to unite with the bulb of the opposite side. 7, Vein leaving the gland of the body of the clitoris and going to join—8, The dorsal vein of the clitoris. 9, Labia minora (*Beaunis* and *Bouchard*).

1st. *External Coat.*—This is cellulo-fibrous, and unites the vagina to the surrounding parts. It is composed of fibres of connective tissue mingled with elastic fibres.

2d. *Muscular Layer.*—This forms two-thirds of the thickness of the vagina. It is composed of superficial longitudinal fibres, which are inserted in front on the ischio-pubic rami, while behind, these fibres are continuous with the external layer of the muscular coat of the neck of the uterus. Below this is a layer of fibres which cross each other, and form a plexiform net-work.

3d. The mucous coat is ashy grey or reddish in color, and about .029 inches thick. It is closely united to the muscular layer, its superficial surface is covered with stratified pavement epithelium, which entirely covers the papillæ which depend from it. Luschka considers it very rich in muciparous glands. Sappey has never found them.

The arteries come from the hypogastric, by the vaginal branch of the uterine arteries, the inferior vesicals and internal pudic. Their final ramifications penetrate to the papillæ.

The veins empty into the venous plexus which passes along the sides of the vagina.

The lymphatics go to the lateral glands of the cavity, and to the inguinal glands.

The nerves are very numerous and come from the hypogastric plexus.

Bulbs of the Vagina.—Kobelt compares them to leeches filled with blood, the buccal extremity of which corresponds to the clitoris, while the body would be attached to the anterior orifice of the vagina.

They are two erectile organs which are, in reality, situated on the anterior and lateral portions of the vagina, below and within the pubic rami. In the state of erection they are 1.3 inches long, .58 inches wide, and from .39 to .46 inches thick.

Their internal concave surface embraces the circumference of the vaginal orifice, their external convex surface is covered by the constrictor vaginæ.

Their anterior border is the point of departure of numerous veins, which communicate with those of the labia minora, and then empty into the intermediate plexus at the bulb and corpora cavernosa. No vein leaves the posterior border. The inferior extremity projects slightly on the transverse diameter of the vaginal orifice. The superior extremity is thin, and slender, and is adjacent to the urethral canal, and the clitoris. It is united to that of the opposite side by veins and smooth muscular fibres. Thus certain authors consider the bulb as a single median organ.

Their structure is identical with that of the corpora cavernosa, and the spongy portion of the urethra in the male.

The vagina is above all an organ of copulation, and serves as the receptacle of the semen, and gives passage to the menstrual flow and the fœtus.

According to Beigel, Eichstädt, Holst, Braune, Pirogoff, Kohlrausch and Luschka, the posterior lip of the cervix being normally directed backward, forms, by its contact with the posterior wall of the vagina, a sort of infundibulum, or small fossa, which is called receptaculum seminis.

The semen is deposited there after ejection. The neck of the uterus, in consequence of the straightening of the organ, at the moment of the congestion determined by coition, thus becomes bathed directly in the fertilizing fluid.

THE BLADDER, URETHRA, AND RECTUM.

The bladder and rectum being contained in the pelvic cavity, and having immediate connections with the internal genital organs, ought to be studied with those organs.

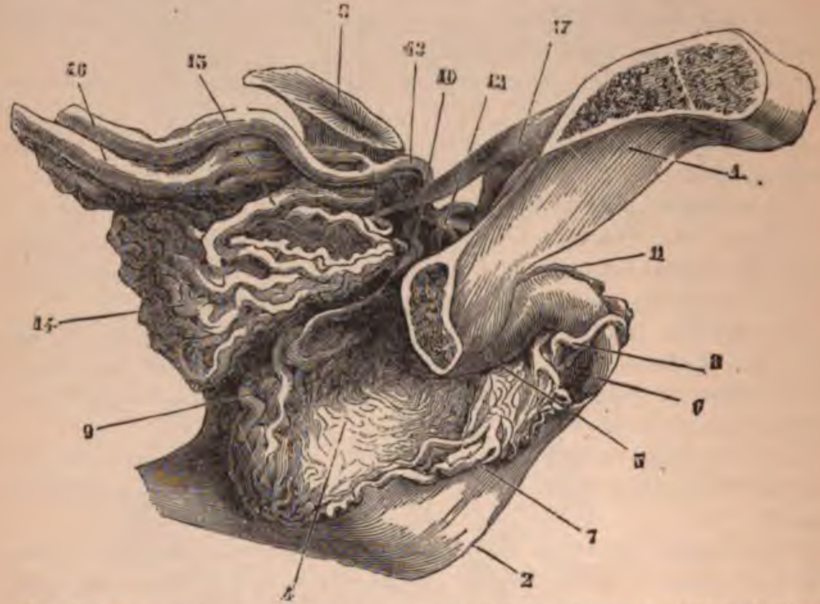


FIG. 51.—ERECTILE ORGANS. (side view).—1. Pubis, 2, Labia Minora. 3, Bladder. 4, Bulb of the vagina. 5, Roots of the clitoris. 6, Gland of the clitoris. 7, Veins passing from the bulb towards the clitoris. 8, Vein going to the dorsal vein of the clitoris. 9, Veins of the posterior portion of the bulb. 11, Dorsal veins of the clitoris. 10, Vein which springs from them. 12, Dorsal vein uniting with the posterior veins of the bulb, to empty into—13, A vesical vein. 14, Vesical plexus. 15, Emulgent vein of this plexus. 16, Vesical veins (*Beaunis* and *Bouchard*).

The Bladder.

This is a musculo-membranous reservoir destined for the urine, and which occupies the anterior portion of the pelvic region, in front of the uterus, and behind the pubes.

When it is filled, the bladder has the shape of an ovoid, the large extremity of which points downward and forward. When empty it forms an isosceles triangle with the base downward. It presents six regions or surfaces: anterior, posterior, superior, inferior and two lateral.

The anterior surface is adjacent to the posterior surface of the pubes, and the inferior wall of the abdomen. It is attached to these portions by the pubo-vesical ligaments, which are situated on the sides of the bladder. They seem to hang from the superior pelvic aponeurosis, and are formed by muscular fibres which proceed from the muscular layer of the bladder. They are covered by the peritoneum.

The posterior surface is contiguous with the uterus above, and blends with it below. Its connections have already been indicated.

The inferior surface or lower end, is limited in front by the urethra and behind by the vesico-uterine cul-de-sac. It presents for consideration the trigone, which is situated on the internal surface of the bladder. At the superior angles are the two orifices of the ureters, at the inferior angle the superior orifice of the urethra. The neck of the bladder is formed by the part of the vesical walls which surround this last-named orifice.

The superior surface or apex of the bladder is in relation with the abdominal walls. In its centre is the urachus, a fibrous cord going to the abdominal wall, and inserted at the umbilicus. The urachus is the remains of the pedicle of the allantoic vesicle.

The lateral surfaces face the sides of the cavity, and are accompanied by the umbilical arteries reduced to a fibrous cord.

The relations of the bladder vary according as it is empty or full. In the latter case it depresses the anterior wall of the vagina, thus making in the interior of this organ a larger or smaller projection.

The cavity of the bladder when empty shows folds and projections due to the retraction of the walls, and to the projection of the bundles of the muscular coat.

Structure.—It consists of a serous, a muscular and a mucous membrane.

Serous Membrane.—It is covered by the peritoneum, only at the posterior, lateral and superior regions. From here it folds forward upon the abdominal walls .78 to 1.1 inches above the superior margin of the pubes, behind on the anterior surface of the uterus, and there forms the vesico-uterine cul-de-sac.

Muscular Structure.—This has three layers: a superficial, composed of longitudinal fibres; a middle, of circular fibres; an internal, of fibres that interlace in all directions. At the neck of the bladder the circular fibres form a true sphincter.

The mucous membrane is pale, thin, smooth, covered with pavement epithelium, and adheres feebly to the muscular membrane. It forms numerous folds in the interior of the vesical cavity.

The arteries come from the hypogastric and its branches.

The veins form an important plexus about the neck and inferior part of the organ. They join the hypogastric vein.

Sappey denies their existence, but, according to other authors, the lymphatics of the mucous membrane go to the pelvic glands.

The nerves come from the hypogastric plexus.

The Urethra.

This leads from the neck of the bladder and ends at the urinary meatus. Its length is about 1.5 inches, its width about .27 inches. It is slightly oblique from above downward, and from behind forward, and is very dilatable. It describes a curve, concave in front, which corresponds to the posterior surface of the symphysis. Its inferior extremity passes between the roots of the clitoris, below the free edge of the triangular ligament from which it is separated by cellular tissue.

The posterior surface is closely united to the vagina, in which the urethra is encased.

It is lined internally by mucous membrane, remarkable for three permanent and parallel longitudinal folds, and for numerous openings of mucous crypts. It has a layer of longitudinal fibres, and one of circular fibres, mingled with fibres of connective and lamellar tissue.

The ureters are two small conduits, which bring the urine from the kidneys to the bladder, and which open into the cavity of that organ at the superior angles of the trigonum vesicæ.

The Rectum.

This is the terminal extremity of the large intestine, and the immediate prolongation of the sigmoid flexure of the colon, which occupies the left iliac fossa. Leaving the left sacro-iliac synchondrosis it passes to the right, descends in front of the sacrum, which it reaches at the level of the third sacral vertebra, reaches the extremity of the coccyx, whence it passes downward and forward, then turns sharply backward to cross the perineal floor where it ends in the anus.

It has an anterior and a posterior surface.

The anterior surface is close to the uterus above, and the vagina below, uniting with this latter organ to form the recto-vaginal fold.

The posterior surface is next to the sacrum and coccyx, to which it is united by a fold of the peritoneum which forms the meso-rectum.

At its extremity the rectum is surrounded by the superior pelvic aponeurosis, the levator ani, the sphincter, a large vascular plexus, and the cellular tissue of the ischio-rectal cavity, which we have described above.

The internal surface of the rectum shows longitudinal folds, the columns of the rectum, and semi-circular folds. Its cavity, very narrow at its superior portion, widens below and forms the ampulla of the rectum.

Structure.—A peritoneal coat, which forms the meso-rectum.

A muscular layer, formed of two fibrous layers, one with longitudinal fibres, the other with circular fibres. Some of these latter often form a circular ring 2 to 3 inches above the anus, called by Nélaton, the internal sphincter ani.

The mucous membrane is closely united to the muscularis in the upper portion of the rectum; it is, on the contrary, very loosely attached to the lower portion, especially in the child, whence the frequency of prolapsus of the mucous membrane in the latter. Below the internal sphincter are curvilinear folds, called semi-lunar valves. They enclose large tubular glands.

Vessels and Nerves.—The arteries come from the inferior mesenteric, the hypogastric, and the internal pudic.

The veins form a true plexus, the hemorrhoidal plexus. They empty into the inferior mesenteric and hypogastric veins.

The lymphatics go to the lumbar glands.

The nerves come from the hypogastric and sacral plexus.

The rectum terminates in the anus. The anus is situated 1 inch in front of the apex of the coccyx. At the periphery, where the rectal mucous membrane unites with the skin, it shows a series of folds which disappear by distention. It forms a true canal composed of two portions, one mucous, to which the internal sphincter is joined, the other cutaneous, to which the external sphincter is joined.

CHAPTER III.

THE EXTERNAL GENITAL ORGANS.

THESE are essentially organs of copulation. They consist of the vulva, which is limited above by the mons veneris.

MONS VENERIS.

This is a rounded eminence which is situated in front of, and a little above the symphysis and the body of the pubes, and which is limited above by the hypogastrium, laterally by the fold of the groin, and below by the labia majora. At the time of puberty this region, the skin of which is remarkable for the development of its hair follicles and of its sebaceous glands, is covered with hair. A layer of adipose tissue, the thickness of which varies in different individuals, covers it throughout its whole extent. It is crossed by a great number of lamellæ, composed of fibres of elastic tissue. Here also are muscular fibres, coming from the round ligament, and the superior portion of the superficial aponeurosis of the perineum.

THE VULVA.

Forming a sort of flattened ring, with a long longitudinal diameter, directed from above downward, and from in front backward, the vulva is composed of the labia majora, the labia minora, the clitoris, the urinary meatus, and the vestibule. Besides these we find the hymen and the myrtiform caruncles, and the navicular fossa with the vulvar orifice.

I. *Labia Majora.* (*See Fig.* 52.)

These are two folds of skin, which extend from the anterior and median part of the mons veneris, to the anterior portion of the perineum. In the centre they are separated by the vulvar cleft, but they unite above and below to form the vulvar commissures.

The anterior commissure is round, and is above the clitoris, from which it is separated by a space of about ½ inch. The posterior commissure is more acute. This latter unites with the corresponding part of the perineum and forms a prominent fold, called the fourchette. This fold is separated from the entrance of the vagina by a depression that forms the fossa navicularis.

The external surface of the labia majora is convex and covered with hair. It is separated from the thigh by the genito-crural groove or fold.

The internal or mucous surface is almost completely without hair, is of a rosy color, and is applied to the corresponding surface of the opposite labium.

The anterior edge is free, rounded, and slightly convex.

The posterior edge is attached to the ischio-pubic ramus, and is continuous with the soft tissues of the surrounding parts.

In virgins and stout young women, the labia majora are firm, thick, even, and fit exactly one against the other; in multiparæ, and aged or thin women they are flabby and loose. The vulva, which is closed in the former, is slightly open in the latter. It is even the same in children on account of the incomplete development of the labia.

Structure.—The skin of the labia majora is noticeable for the development of its hair follicles and sebaceous glands. It also contains sudoriparous glands, remarkable for their size and number.

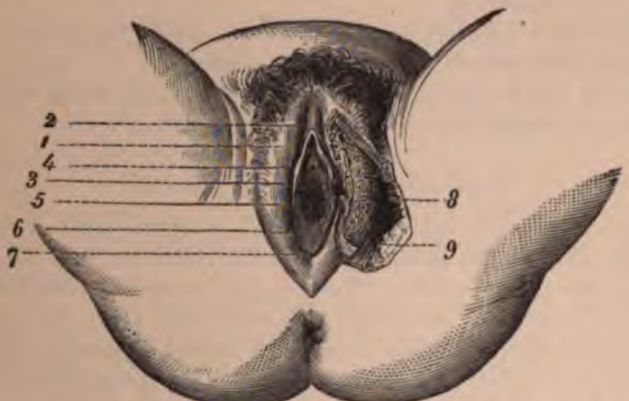


FIG. 52.—THE VULVA.—1, Labia Majora. 2, Clitoris. 3, Labia Minora. 4, Meatus urinarius. 5, Orifice of vagina. 6, Fossa navicularis. 7, Fourchette. 8, Gland of Bartholini. 9, Its duct.

Below is found what Sappey called the elastic apparatus of the mons veneris and the labia majora. It is composed of an anterior portion, two lateral lamina and a posterior part.

The anterior portion is composed of a series of lamellæ, which pass from the hypogastric and the superior edge of the pubes to the mons and labia majora. They divide into several groups: a median, which forms the superior ligament of the clitoris, and which passes to the right and left of the vaginal bulb and the constrictor vulvæ, to finally blend in the perineum with the thin elastic lamina that proceeds from it. Two lateral, which descend in front of the inguinal ring, and blend with the median and lateral lamellæ.

On the external and anterior edges of the labia majora are smooth fibres which form the dartos of woman. They only differ from the dartos in man by the atrophy of the fascia, and the fibres which compose it. In woman the two fascia do not unite, but remain separate, so that the dartos is really double.

Broca described a special pyriform sac situated in the thickness of the labia majora, and the large end of which pointed downward, and backward, while the small end pointed upward, forward and outward, towards the orifice of the inguinal canal. He called it the dartoic sac of woman. Sappey has shown that this sac is not, like the dartos, composed of muscular fibres; that it is not a true dartos, but that it is composed of elastic fibres which cross each other. He described it under the name of the elastic apparatus of the labia majora.

The cellular tissue forms an adipose layer between the dartos and the elastic apparatus. It accumulates especially in this latter, and thus helps maintain the shape of the labia majora.

The arteries come from the inferior perineal, from the external pudic, and from the epigastrics.

The veins unite with the veins of the bulb.

The lymphatics pass only to the inguinal glands.

The nerves come from the genito-crural branch of the lumbar plexus, and from the perineal branch of the internal pudic.

II. *Labia Minora.* (*See Fig.* 52.)

The labia minora are two cutaneous folds, situated between the majora and at the sides of the urinary meatus, the vestibule, and the superior portion of the vaginal orifice. They are, on an average, from 1.1 to 1.5 inches long, from .39 to .46 inches wide, and from .11 to .15 inches thick. In some women they are much larger, and instead of being, as in the normal condition, concealed between the majora, they project very noticeably. In the Bosjesmans they are so large that they form what is called the Hottentot's apron.

They have two edges and two extremities.

The external surface is next to the internal surface of the corresponding large labium.

The internal surface is applied against the corresponding face of the opposite small labium. It covers the clitoris, the urinary meatus, and a portion of the vaginal orifice. Hence the necessity, when the urinary meatus is sought for, of separating the labia minora between which the meatus is concealed.

The posterior edge is adherent, divides into two parts, and is continuous externally with the majora, and internally with the vestibule, and the periphery of the vaginal orifice.

The anterior edge is free, convex, and irregularly denticulated.

The posterior extremity never passes the transverse diameter of the vaginal orifice, and gradually merges into the walls of the vulva.

The anterior extremity is divided into two parts: the inferior is very short, is united to the free end of the clitoris, and is continuous with that of the opposite side. The superior part unites with that of the opposite side above the clitoris to form for it a prepuce.

Structure.—They are formed by a fold of the vulvar mucous membrane, which contains connective tissue, rich in elastic fibres, and numerous blood vessels. They are covered with stratified pavement epithelium, and have numerous papillæ placed in rows on their internal surfaces. They also have numerous sebaceous glands.

The arteries are formed by branches which pass to the labia majora.

The veins unite by large anastomoses with the veins of the bulb and of the vagina.

The lymphatics pass to the inguinal glands.

The nerves proceed from the perineal branch of the internal pudic.

THE CLITORIS.

This is an erectile organ, analogous to the corpus cavernosum in man. It springs from two roots, which are attached to the ischio-pubic rami, and which unite in front of the symphysis to form a single body. These roots are very slender, ascending, and are situated between the pubic arch and the bulbs of the vagina. (Figs. 50 and 51).

It is attached to the inferior and anterior portion of the symphysis, by a suspensory ligament, in front of the vestibule and between the labia minora, which furnish a prepuce for it. It ends in a conoid extremity, the glans clitoridis.

Its structure does not differ from that of the corpus cavernosum in man. The same fibrous envelope, which is an emanation from its suspensory ligament, the same partition, the same areolar layer formed by muscular trabeculæ, by dilated inosculated capillaries, by helicine arteries, by veins and nerve filaments. It is essentially an erectile organ.

The arteries of the clitoris are the dorsal and cavernous, a branch of the internal pudic. The veins end in the vesico-urethral plexus. The nerves spring from the internal pudic nerve.

Kobelt has carefully studied the erectile apparatus of the genital organs of woman, and we refer the reader to his work for further details.

THE VESTIBULE.

This is a triangular surface, limited on the right and left by the labia minora, above and in front by the clitoris. Its base is, in the median line, the urinary meatus, and on each side the orifice of the vagina. This surface has some papillæ and a small number of simple sebaceous glands.

THE URINARY MEATUS.

This is the external orifice of the urethra. It is situated on the median line immediately above the tubercle which terminates the superior wall of the vagina, and between the two labia minora, and is covered by their internal surface. This opening is often placed at the centre of a small, round and projecting cushion, sometimes even on the level of the mucous membrane of the surrounding parts. This arrangement allows it to be found on examination without uncovering the woman. After confinement, the swelling and the deformity of the parts, sometimes render it difficult to find, and makes catheterism very difficult, even when the woman is uncovered. The best procedure is to separate the labia minora with the index and middle finger of the left hand, drawing them at the same time slightly upward. The orifice of the meatus then opens a little and the catheter can be easily introduced. If done gently and lightly this small operation is scarcely painful even in women whose genital parts are swollen. [As is noted further on, the catheter should never be passed by touch, but always by sight—Ed.]

THE VULVO-VAGINAL SECRETORY GLANDS.

The glands which compose the vulvo-vaginal secretory organs are the sudoriparous glands, the sebaceous glands, the muciparous follicles, and two special glands, the vulvo-vaginal glands.

Sudoriparous Glands.—They are found on the mons veneris and the external surface of the labia majora. They are mingled with the sebaceous glands and surround the base of the hair follicles.

Sebaceous Glands.—They occupy the mons veneris, the internal surface of the labia majora, the two surfaces of the labia minora, the fourchette, and the prepuce of the clitoris, but they are never found in the vestibule, or at the circumference of the urinary meatus.

Muciparous Follicles.—They appear in two forms, either singly or in groups. Sappey denies their existence. Huguier describes four groups.

1st. *Vestibular Follicles.*—8 or 10 single ones; they are only recesses in the cul-de-sac of the mucous membrane.

2d. *Urethral Follicles.*—They are numerous according to Huguier; and scarce according to Robert. Several of these follicles are sunk in the cellulo-vascular tissue of the urethra, and open at the surface of the median tubercle situated immediately below the meatus.

3d. *Lateral Urethral Follicles.*—They are smaller and all their orifices are united at the bottom of a conical depression. They do not invariably exist.

4th. *Lateral Follicles at the Entrance of the Vagina.*—These are two or three, and they are situated on the lateral portions of the entrance of the vagina, immediately below the hymen or the myrtiform caruncles.

The Vulvo-vaginal Glands.—(The glands of Bartholin, Duverney, and Cooper.) They have been studied by Huguier, who called them the vulvo-vaginal glands. They belong to the class of globular glands. There are two of them, a right and left, situated in the lateral and posterior portion of the vagina, about .39 of an inch above the anterior surface of the hymen, or the myrtiform caruncles, in the angular space which results from the approximation of the rectum and vagina, and below the inferior extremity of the bulb.

Very small in infancy and atrophied in old age, they are, in the adult, very nearly the size of the kernel of an apricot. They present an internal surface, which adheres to the vagina, and an external surface, which is covered by the constrictor vaginæ and the perineal branch of the internal pudic nerve.

Structure.—They are composed of lobes, lobules and granulations, the canaliculi of which unite in a single canal which opens immediately in front of the hymen in the angle which it forms with the vulva. This canal is about ½ inch long, and about .11 of an inch wide.

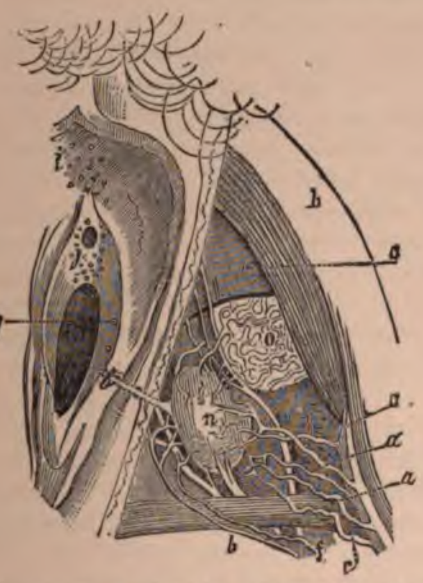


FIG. 53.—SECRETORY APPARATUS OF THE VULVA; THE VULVO-VAGINAL GLAND, WITH ITS VESSELS AND NERVES, ALONG WITH THE FOLLICLES OF THE VULVA (after *Huguier*).—The external two thirds of the left labia majora, the skin, the sub-cutaneous cellular tissue, the superficial aponeurosis of the perineum, and the constrictor vaginæ muscle of the same side are removed. *aa*, The two principal arteries of the gland. *h*, *f*, Branches coming from the perineal artery. *cc*, Veins. *g*, Lateral follicles of the entrance of the vagina. *h*, Ascending ramus of the ischium. *i*, Follicles of the vestibule. *j*, Follicles of the circumference of the urethra. *l*, Excretory orifice of the vulvo-vaginal gland. *n*, The gland. *o*, Bulb of the vagina.

The greater portion of the gland is covered by a fibro-cellular lamina, which sends prolongations into the intervals between the lobes and lobules.

The arteries come from the artery of the clitoris. The veins form a net-work on the surface of the organ, and empty into the pudic veins, as well as into the venous plexus of the vagina and the bulb.

The lymphatics pass to the ganglia situated in the cellular space between the walls of the rectum and vagina.

The nerves come from the internal pudic.

The glands secrete a ropy, oily fluid, which, by lubricating the external parts, facilitates copulation.

CHAPTER IV.

THE MAMMÆ.

THE mammæ are glandular organs which secrete the milk for the nourishment of the new-born child. They can therefore be truly considered as part of the genital organs.

Position and Shape.

They are two in number, placed on the anterior and superior part of the chest, on the right and left of the sternum, in front of the pectoralis major, and in the space between the third and seventh rib.

Rudimentary in man and little girls, they develop to the time of puberty, increasing in size during pregnancy, and attain their greatest development after confinement, under the influence of the secretion of milk. Their size is extremely variable in different women, and especially in different races. The left breast is often larger than the right.

The gland is generally hemispherical, but often has a conical or discoid shape. Their shape is greatly changed in aged or thin women, and more than all in women who have nursed.

Their external surface has three distinct zones: a white peripheral part, smooth, soft and yielding to the touch, a middle part which forms the areola, and a central projecting part, the nipple.

The areola is rosy in young girls, and is colored in pregnant women. This color is generally the same as the color of the hair. Next to nothing in blondes, this coloration increases in brown-haired women, and sometimes becomes very deep in brunettes. This coloration divides the areola into two parts—one central, the true areola, and the other eccentric, surrounding the latter. This is the secondary areola, which is mottled or spotted. We will return to this when we study the changes in the genital organs caused by pregnancy.

The skin of the true areola contains a large number of sebaceous glands; also, a dozen or twenty projecting tubercles which, according to some writers, are only sebaceous glands, to others (Depaul), true rudimentary nipples, from which it is easy to extract a liquid which shows, under the microscope, all the characteristics of milk. Sappey explains this from the fact that each of these sebaceous tubercles is crossed by a little galactophorous duct coming from a supplementary lobule connected to the gland. (Figs. 54 and 55.)

The deep surface of the areola is lined with a layer of muscular fibres placed in a circle around the areola, forming a true orbicular muscle —whence the peculiar retractile power of the areola.

At the centre of the areola is the nipple, shaped like a conoid or cylindrical projection, with a round end. It is from .35 to .42 of an inch high, and about .39 inches wide, but its form and size vary greatly in different women. In some cases it sinks into the areola and recalls the arrangement of the umbilicus. Its surface is covered with highly developed papillæ, so developed and so compact that in some women the nipple has a true muriform appearance. Below the skin of the nipple is a connective tissue of elastic and muscular fibres, analogous to that of the areola. It is crossed from its base to its apex by galactophorous ducts which open at its free end.

The posterior surface of the mamma is a plane. A cellulo-fibrous lamina covers it and separates it from the pectoralis major, to which it adheres by a loose cellular tissue.

Its circumference is encircled by a cellulo-fatty layer, which forms its principal means of support.

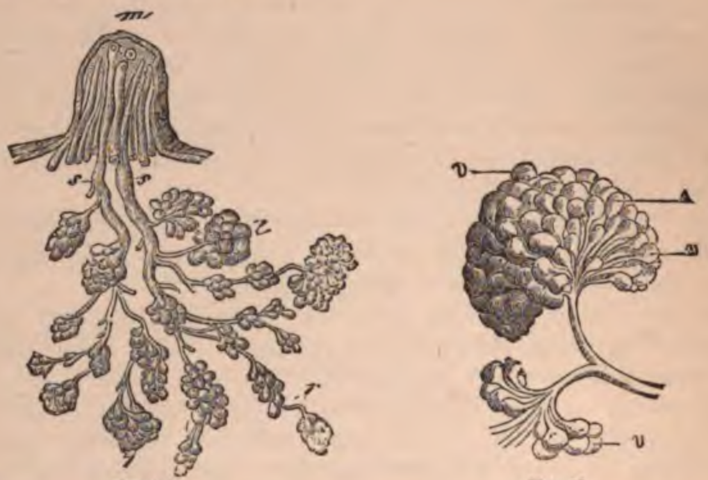


FIG. 54. FIG. 55.

FIGS. 54 and 55.—STRUCTURE OF THE MAMMÆ.—*l*, Lobules. *m*, Nipple. *r*, Canaliculi. *s*, Sinus of the galactophorous canals. *v*, Vesicles or acini (*Cloquet*).

Structure of the Mammæ.

The breast consists of skin, the cellulo-fatty layer that lines it, and the mammary gland.

The skin of the peripheral part has the same structure as the skin of the trunk. It contains hair follicles, rudimentary sebaceous glands, and muscular fibres, which are attached to their inferior part, and which contain the glands. It rests on a cellulo-fatty layer which holds it like a cushion.

The areolar part is smaller and more delicate. Its derma consists entirely of fibres of connective tissue and of elastic fibres. It contains hair follicles, sebaceous glands, sudoriparous glands, and its internal surface adheres to a sub-areolar orbicular muscle.

Mammary Gland.—It is situated below these parts in a fold of the fascia superficialis. It forms a hard mass, thicker in the centre than at the periphery. It is composed of 15 or 20 lobes separated from each other by a fibrous covering and by adipose tissue. Each lobe is subdivided into lobules, which are only the union of the acini enlarged at their end. (Fig. 56). From each acinus springs a canaliculus which unites with neighboring canaliculi. The ducts of the lobules unite in their turn and form, finally, the galactophorous ducts. There are 15 to 20 of them.

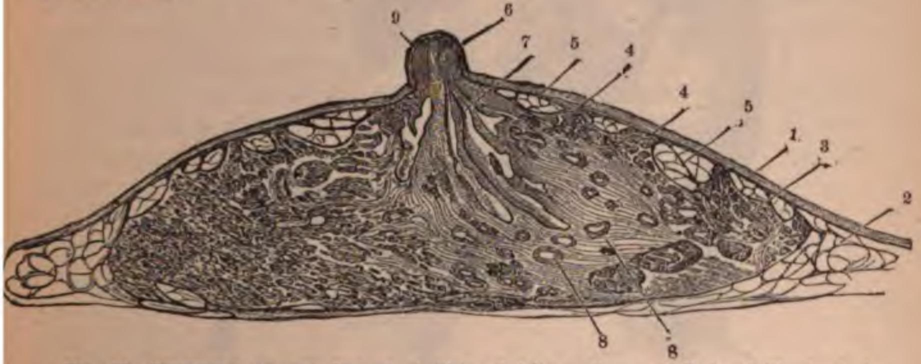


FIG. 56.—STRUCTURE OF THE BREAST. 1, Skin. 2, Adipose tissue. 3, Body of Gland. 4, 4. Crest-like projections of gland. 5, 5. Fat masses between the crests. 6, Milk ducts. 7, Sinus of milk ducts. 8, 8. Section of milk ducts in glandular tissue. 9, Nipple.

At the base of the nipple, under the areola (Fig. 56), they dilate to form the lacteal sinus, then enter the nipple, and cross it entirely, opening into the grooves which separate the papillæ. Their walls inclose muscular fibres. The acini have a cuboid epithelium; the galactophorous ducts near the nipple, have, according to de Sinety, a cylindrical epithelium. Whatever Paul Dubois may have thought of them, these galactophorous ducts do not inosculate, but enter the nipple separately.

The arteries come from the external and internal mammary and from the intercostals.

The veins go into the internal mammary and axillary. Of these veins, a certain number are sub-cutaneous and at times form, under the areola, an incomplete circle, called Haller's circle.

The nerves come from the thoracic branches of the brachial plexus and from the intercostal nerves.

The lymphatics spring from the gland and the skin; the glandular go to the axillary ganglia, those of the skin enter the sub-areolar plexus. According to Cadiat the breast of a nullipara is formed of a hard mass, commencing at the nipple, and stretching circularly below the derma so as to form a thick plate, resting on the fatty tissue which separates it from the aponeurosis of the pectoralis major. It is formed of fibrous tissue crossed by fine ducts, the first features of the glandular elements, which develop in consequence. Primitively, in the embryonic period, this layer is a mass of nuclei, lenticular in form, placed below the derma.

According to Langer, in the centre of this lenticular body is a little fossa, which is the centre around which the canals of the gland, or rather the epithelial cylinders that they represent, will develope. From the time of puberty, the two parts which form the breast, namely the fibrous layer and the galactophorous ducts, develop simultaneously, but these last are only an insignificant part of the organ, in a well-formed breast. In a young girl there are no true glandular elements, only simple epithelial buds forming full cylinders as in the fœtus.

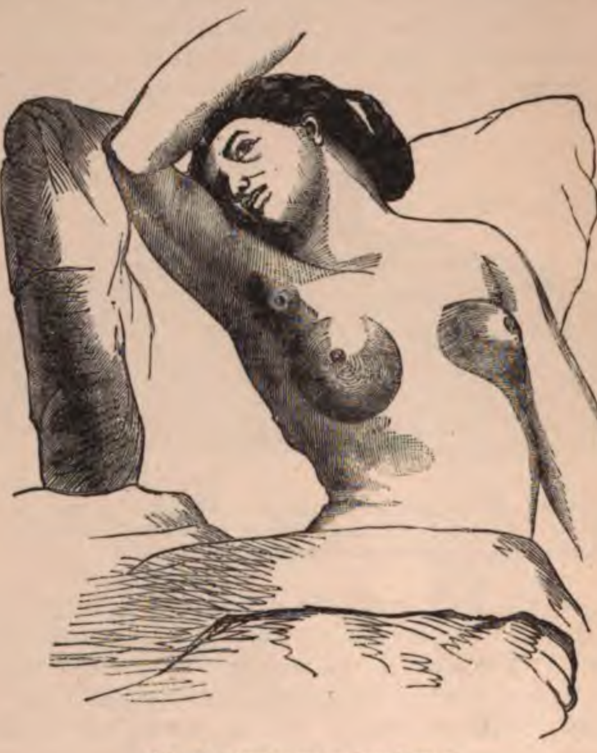


FIG. 57.—ANOMALIES OF THE BREAST.

In a pregnant woman the breast undergoes great changes. The glandular proportion exceeds that of fibrous tissue; the ducts are not yet permeable, but at the centre is already noticeable a certain quantity of fatty particles. It is only in pregnancy that the glandular structure is completed.

After pregnancy, it is the fibrous nuclei which take the place which the glandular vesicles occupy during lactation.

After the menopause retraction is still more rapid. The fibrous layer contracts little by little, and, in its place, are only found fatty deposits crossed by the larger galactophorous canals, which still remain, and which contain a greenish yellow serosity.

ANOMALIES.

The mammary glands present at times very curious anomalies. Thus, there are women who have more than two mammæ. Tarnier saw two thoracic and two abdominal mammæ. All contained milk; and it is not rare to see women having, after confinement, separated lobules of the gland, simulating supplementary mammæ.

The existence of the supplementary nipple is less rare. We show (Fig. 57) a woman seen by us in the clinic who had four nipples; two axillary, two thoracic. The supplementary nipples were smaller, though regularly formed. They gave milk the same as normal nipples.

PART II.

Physiological Phenomena.

CHAPTER I.

PUBERTY, NUBILITY, OVULATION, MENSTRUATION.

PUBERTY. NUBILITY.

THE period of transformation, during which woman passes from the condition of a child to that of a young girl, or from infancy to puberty, requires for its complete development a relatively long lapse of time. The whole economy of the young girl is deeply affected, and the changes that take place in that economy are indicated by a series of physical and moral, external and internal modifications, the whole of which, taken together, constitutes what is called puberty. Now a woman may be pubescent without being nubile; for, as Pajot observes, nubility implies the idea of an aptitude, while puberty implies a particular condition which aids and renders possible the exercise of that aptitude. A young girl may, then, be pubescent without being nubile, but nubility must necessarily be preceded by puberty.

During this period of transformation, the breasts of the young girl become larger, the pelvis widens, the thighs becomes more prominent, the pubis is covered with hair, and the character changes.

At the same time, there appear two functions which indicate the part taken in this transformation by the two essential internal organs of woman, the ovary and the uterus: these are ovulation and menstruation.

Puberty, then, renders fecundation possible, but nubility alone renders it possible for this fecundation and its consequences to be borne without inconvenience.

OVULATION. MENSTRUATION.

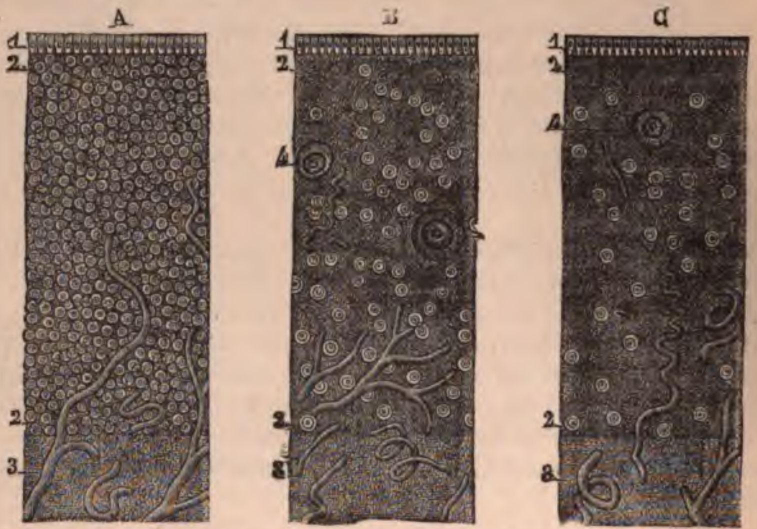
These two functions are considered as one, the last being the external manifestation of the first. We will see that, during the last few years, a number of authors tend to oppose this view.

By ovulation we mean those phenomena which occur in the ovary, and which consist in the maturing, the rupture of the Graafian vesicle, and the departure of the ovum from the vesicle. This last is followed by the migration of the ovum, and the cicatrization of the Graafian vesicle, or the production of what is called the corpus luteum.

Maturation and Rupture of the Graafian Vesicle.

We have seen that, until puberty, the Graafian vesicles form the ovigenetic layer of the ovary (Figs. 58, 59, 60), which is then smooth and uniform.

At the beginning of this period, fifteen or twenty of these vesicles develop much more than the others. One of these especially seems to attract all the productive activity; it develops to a considerable extent, forms a more and more marked projection on the surface of the ovary, which it continually approaches, and finally becomes almost as large as a cherry. Under the influence of this development, the vessels of this vesicle, which are lengthened and compressed by this distension, become atrophied, and even obliterated at the highest point (Fig 61). Its wall grows gradually thinner, finally to burst, and the ovum, forced from the ovary, is received by the pavilion of the tube. This phenomenon, which is reproduced every month, constitutes spontaneous ovulation. There occurs here a phenomenon analogous to that which happens at the rupture of an acute abscess.



FIGS. 58, 59, 60.—VERTICAL SECTION OF THE OVIGENETIC LAYER, SHOWING THE OVISACS AND OVA IN NEW-BORN CHILD, IN A GIRL OF 4 AND IN A WOMAN OF 20. *A*, New-born child. *B*, Girl of 4. *C*, Woman of 20. 1, 1, 1, Epithelial layer composed of a single layer of prismatic cells. 2, 2, 2, The ovigenetic layer meeting the epithelium of the ovary. The ovisacs seem much more numerous in the fœtus, *A*, because they are already further apart in the girl of 4, and still more so in the woman of 20, *C*. 3, 3, 3, Subjacent portion of the bulb of the ovary. 4, 4, 4, Vesicles more developed than the surrounding ovisacs, and in which the ovum is very apparent (*Sappey, Traité d'Anatomie Descriptive.*)

The liquid which the vesicle of de Graaf normally contains, gradually increases, and flows into the cavity of the ovisac, thus distending and thinning its walls more and more, which, having reached the limit of their resistance, give way and burst, allowing the liquid and the ovum to escape. This requires a space of time that varies generally between six and eight days, and is accompanied by a swelling, a marked tumefaction of the ovary on the side where the vesicle developed. The researches of Puech, Depaul and Guéniot, leave no doubt of this.

The height and thickness of the organ are especially modified. This developement of the ovary is due to the congestion, which is produced in the ovary at the time of evolution of the follicle; and this congestion is greater when the follicle that develops is deeply situated, and has a longer path to traverse in order to reach the surface of the ovary. In certain cases blood effusions are produced either in the hypertrophied vesicle, or in the neighboring ovisacs, or in the bulk of the ovary. Again, the rupture of the vesicle of de Graaf may take place in a slow and gradual manner. The true membranes are first torn, and it always results from this that a small bloody extravasation occurs at their summit. The peritoneum yields last, but it is very rare that this hemorrhage is sufficient to form a clot capable of filling the follicle of de Graaf. Ordinarily, it is limited to slightly tinting the fluid that effuses in the vesicle after the expulsion of the ovum.

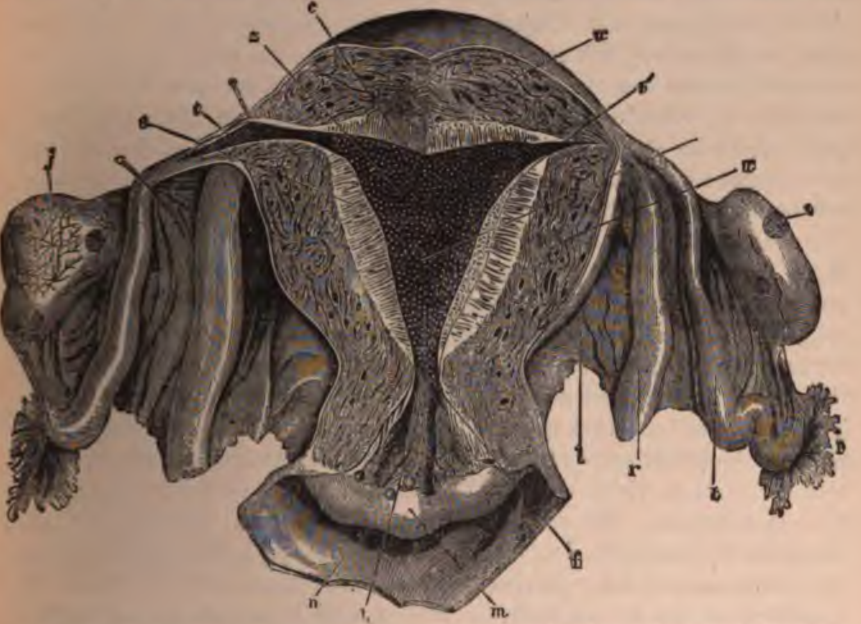


FIG. 61.—VESICLE OF DE GRAAF ON THE POINT OF RUPTURE. (*Coste*). *c*, *c'*, Section of the uterine mucous membrane, on which are the orifices of the uterine glands. *f*, Internal orifice of the uterus. *u*, Muscular wall of the uterus and sections of a number of veins. *m*, Vaginal portion of the cervix *n*, Vagina. *h*, Mucous membrane of the cervix. *z*, Cavity of the uterus. *l*, Broad ligaments. *r*, Round ligaments. *t*, Tube. *o*, Ovary. *v*, Vesicle of de Graaf. *l'*, Orifices of the tubes. *p*, Pavilion of the tube. *j*, Vesicle of de Graaf, at the point of rupture. (Virgin girl, who committed suicide during the inter-menstrual period).

Migration of the Ova.

At the moment when the Graafian vesicle ruptures and allows the ovum to escape, the tube is applied to the ovary, and surrounds it with its pavilion; hence the ovum penetrates the pavilion, and from there passes into the canal of the tube, which conducts it to the uterus.

According to the older authors,—Haller at their head,—this adaptation of the tube to the ovary is due to the contraction of muscular fibres situated within the walls of that organ. Many of them, struck by the violet color of the tube, and by its hyperæmia at the time of menstruation, admit a true erection of the tube. According to Rouget this fluxion is not sufficient, and he explains this adaptation by the direction of the muscular fibres, which he discovered and studied, in the ovary, the tube and the pavilion. The ovum, seized by the pavilion, is thus forced into the tube by the contraction of these muscular fibres. This explanation does not satisfy modern writers, and each one has given one of his own. Although Kehrer, and Liègeois regard this phenomenon as a true ejection from the ovary, which throws the ovum into the pavilion, just as the semen is thrown into the vagina, yet, according to Kiwisch and Schroeder, the cells of cylindrical epithelium with vibratile cilia, which the tube possesses at its abdominal extremity, establish around that orifice, and in the serous fluid that continually lubricates the peritoneum, a continuous current capable of carrying with it particles as small as an ovum. The existence of this serous current has been demonstrated by Becker. If, on the contrary, the ovum does not reach the interior surface of the pavilion, it is lost in the abdominal cavity, and this explains the so-often negative results of sexual intercourse, and extra-uterine pregnancy. According to Schroeder, this serous current may be strong enough to carry the ovum, expelled from one ovary, to the tube of the opposite side. This is what is called external migration of the ovum. These external migrations take place in cases of deviation or of obliteration of one of the tubes by inflammation, which has brought about adhesions or the production of false membranes. The cases of Rokitanski, Czihak, Luschka, Drejer, Scanzoni, Oldham, etc., confirm this theory. Leopold, of Leipzig, studied this question, and, after having repeated the experiments of Parsenow, and discussed the known facts, he arrives with Kussmaul at the following conclusions: The ovum, ejected by the ovary of one side, may enter the tube of the opposite side, when the vibratile current of this latter carries it towards the ovary which ejected the ovum. The contact of the two organs is not indispensable for the migration of the ovum, for the vibratile current acts from a distance.

What the Germans call the internal migration of the ovum, and what is observed in animals where the two cornua of the uterus are separated, is questioned in the human race, although a case of Schultze seems to prove the possibility of it. This was a case of tubal pregnancy, in which the abdominal extremity of the tube developed by pregnancy was closed by adhesions. The ovum in this case seemed to have been seized by the tube of the healthy side, to have crossed the uterus, and entered the other tube by the uterine orifice, and to have been finally developed in this latter organ. The question in this case is, above all, whether the obliteration of the tube was not consecutive to the penetration of the ovum.

According to Henle, there is on the ligament that unites one of the fringes of the pavilion to the ovary, a groove covered (as Waldeyer has proved) with epithelium, with vibratile cilia. The ovum follows this groove to reach the pavilion of the tube.

Whatever be the theory, when once in the pavilion, the ovum enters the canal of the tube, passes its whole length, and reaches the uterine cavity twelve or fifteen days after it has left the ovary. The movement of the cilia, may contribute to this progress, but it is greatly aided by the peristaltic contractions of the tube, contractions which have been proved to exist by Colin in sheep killed during heat.

In the Graafian follicle the ovum is surrounded by the disc or cumulus proligerous. At the moment of rupture, this cumulus proligerous is carried away with the ovum. Its cells disappear during the passage of the ovum through the first external third of the tube. They are then replaced by an albuminoid layer which surrounds the ovum during the rest of its journey through the canal of the tube. This albuminoid layer itself disappears at the uterine orifice of the tube; and the ovum, thus arriving free in the uterine cavity, either dies here when it has not been fecundated, or is, on the contrary, grafted on to it when fecundation has taken place.

In general, the ovaries alternately furnish the ovum, but this is far from always being the case, for the same ovary sometimes makes several consecutive ovulations. In the human race this process of ovulation occurs about every four weeks, to finally cease only at the period of the menopause.

Corpora Lutea.

The rupture of the vesicle of de Graaf is followed by cicatrization, and there results the corpora lutea.

These were described by Fallope, Wölcher-Coiter, Steon, and Regnier de Graaf, and studied by Malpighi, who named them the corpora lutea, and who considered them glands which secreted the ovum to protect it, and to aid its ejection. Regnier de Graaf, the elder, established that it was due to the cicatrization of the follicle, but he was wrong in making it the exclusive result of a fecundating coition. The mere number of cicatrices on the same ovary prove that they could not proceed from former pregnancies. Haller, less exclusive, considered them only as the manifestation of sexual intercourse. In 1837, Coste showed that these corpora lutea were found on the ovaries of virgins, and that they were consequently dependent upon the rupture of the ovisacs, and that this bursting was independent of the act of copulation, and occurred at the time of the menses. In 1821, J. Power, and in 1826, Girdwood, suspected the relation existing between ovulation and menstruation; the latter having found on the ovary of young girls a number of cicatrices nearly equal to that of menstruations. This result was confirmed in 1834 by Robert Lee, but it was not until 1839 and 1840 that Gendrin and Négrier demonstrated that menstruation coincides with the maturation of the follicles of de Graaf, and that this maturation, is followed by the ejection of the ovum, and necessarily leads to the formation of a corpus luteum, without there having been fecundation or even copulation. Bishoff, and especially Raciborski, confirmed this by a series of experiments. Nevertheless, the work of Coste shows that coition has a certain influence on the maturation of the Graafian vesicles.

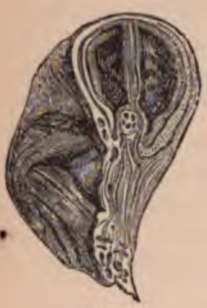


Fig. 62.

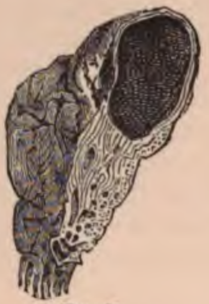


Fig. 63.

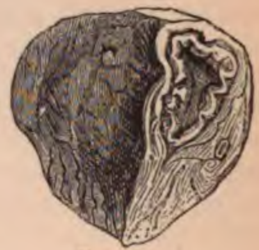


Fig. 64.

Fig. 62.—Fresh Corpus Luteum.—Follicle in complete maturity. (After *Leopold*.)

Fig. 63.—Corpus Luteum of the eighth or ninth Day.—Ovary eight or nine days after the beginning of the last menstruation.

Fig. 64. Corpus Luteum of three Weeks.—Twenty-one days after the beginning of the menstruation, and seven or eight days before the next menstruation.

There is then, according to all these authors, a direct relation between menstruation and ovulation. We have already said that lately certain authors oppose this idea. We will return to this in a few moments.

It is especially *à propos* of the interpretation of the production of the corpora lutea, that writers disagree. Thus, according to Négrier, Jones, Montgomery, Paterson, Robert Lee, Barry, the coloration is due to a deposit of a yellow material between the two layers of the vesicle, a deposit preceding even the rupture of the vesicle, and which serves to repel the ovum and aid its ejection. Yet, according to Pouchet, there forms in the interior of the vesicle, and not between its membranes, a clot which becomes the active agent in the ejection of the ovum. According to Wagner, Bishoff and Coste, the formation of the corpus luteum is due to a growth and thickening of the internal layer, the clot of Pouchet existing only accidentally, and serving only to hinder the formation of the corpus luteum. (Figs. 62, 63, 64.)

According to Coste, Courty, Longet, Kölliker, this phenomenon takes

PLATE III. (After Leopold.)

Fig. 1. Recently ruptured follicle.
Figs. 2 and 3. *g*, recent corpus luteum.
Figs. 4 and 5. *c*, large typical corpus luteum.
a, *b*, recently ruptured follicle.
s, follicles ready to burst.
Fig. 6. *s*, recent typical corpus luteum.
u′, recent cicatrix.
g, next oldest corpus luteum.
u″, its cicatrix.
Fig. 7. *p*, typical corpus luteum is not shown, but the next in age.
Figs. 8 and 9. *c*, typical corpus luteum.
f, a typical corpus luteum.

PLATE IV. (After Leopold.)

Fig. 10. *u*, typical corpus luteum.
f, retrogressing follicle.
Figs. 11 and 12. Large prominent follicle.
h, ruptured follicle, about one day old.
Fig. 13. *c*, large, typical corpus luteum.
k, retrogressing blood clot.
uf, ruptured follicle, filled with blood, and ready to break.
Fig. 14. Typical corpus luteum with cicatrix.
Figs. 15 and 16. *u*, cicatrix of typical corpus luteum.
h, its base; *k*, retrogressed blood clot; *r*, border of corpus luteum; *of*, superficial ripe follicle.

Figs. 17 and 18. *c*, corpus luteum, five weeks old; *cl*, corpus luteum, about ten days old (ovulation without menstruation); *g*, recently ruptured follicle, a typical corpus luteum; *t*, second tubal opening.

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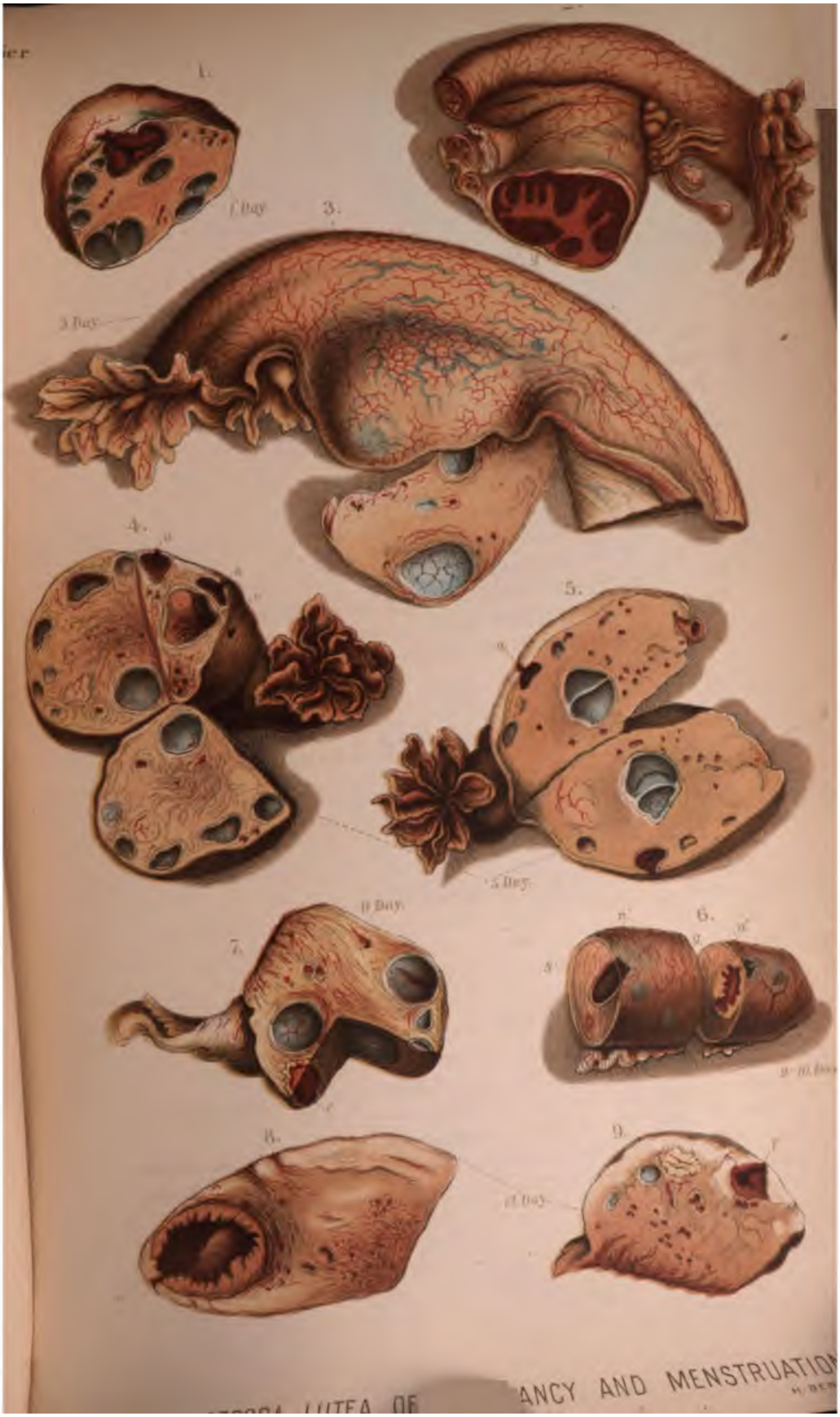

CORPORA LUTEA OF [illegible]ANCY AND MENSTRUATION

H. BEN

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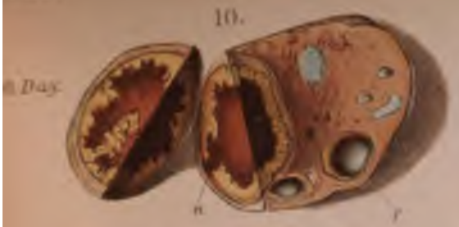

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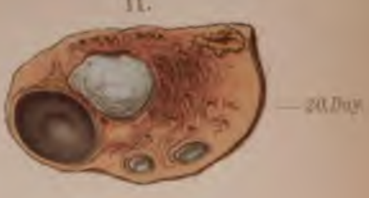

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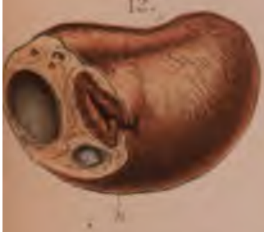

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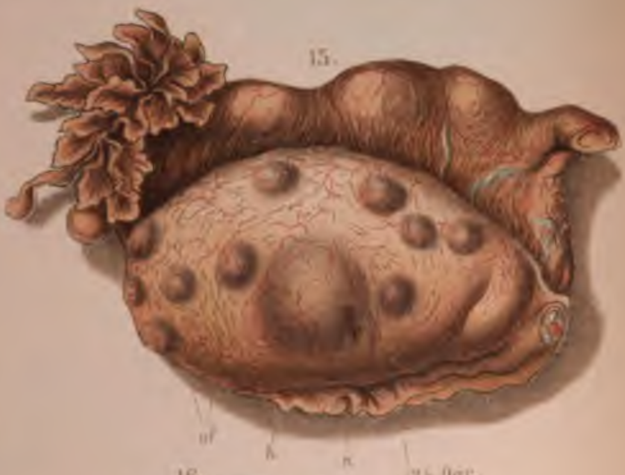

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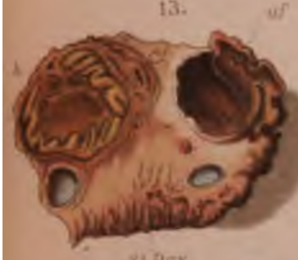

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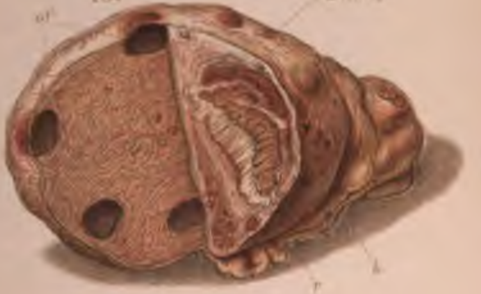

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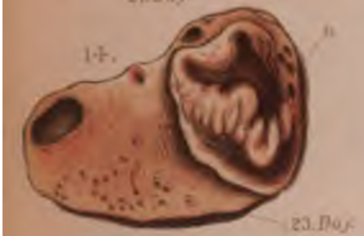

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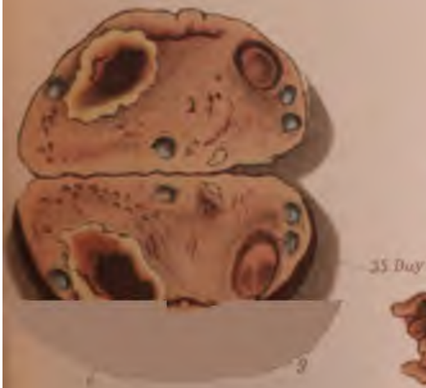

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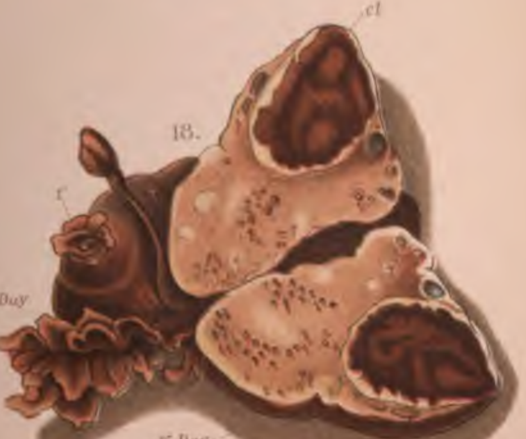


THE CORPORA LUTEA OF [redacted]NANCY AND MENSTRUATION

place as follows: "When the ovum has escaped, taking with it a portion of the cellular layer in which it was imbedded, the internal layer of the Graafian vesicle, which is mucous, thick, non-retractile, and in contact with the remaining portion of that cellular layer, becomes the seat of a profound change, and this modification is manifested by a sort of hypertrophy or tumefaction, and by the distension of the vessels it contains. The external layer, on the contrary, is fibrous, elastic and connected with the stroma of the ovary. It does not participate in this change, but it retracts. Its retraction, coincident with the tumefaction of the former, which is united to it at certain points by fibres, causes the formation of folds in the internal layer. These folds soon come into contact, and give the interior of the vesicle the appearance of the cerebral convolutions. This aspect becomes more marked when the internal layer is most swollen, and the external layer greatly retracted. Now, the corpus luteum results from this hypertrophy of the internal layer, and the retraction of the external. When the cause of so pronounced a thickening of the internal layer of the ovarian capsule is sought, it is found to be due simply to the development of the cells that compose this tissue. They increase little by little, and finally reach a diameter six or eight times as great as that which they had before rupture. The molecular granules which they contain multiply, and are converted into large globules. This individual increase of the cells necessarily produces that of the membrane which they form. The layer of cells that covers the internal layer is raised by the convolutions of the latter, but it plays a passive part, and does not participate in its hypertrophy. The tumefaction of the layer increases till the vesicle of de Graaf is obstructed. From the thirtieth to fortieth day of pregnancy, the convolutions form straight adhesions, which efface their contour. The corpus luteum appears as a compact mass, and the tumor, which gradually increased, retrogrades.

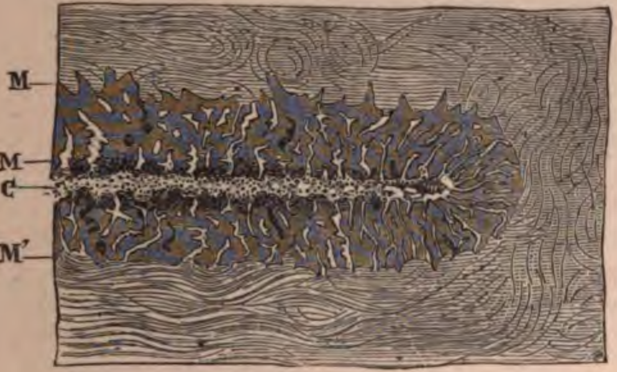


FIG. 65.—TRANSVERSE SECTION OF THE MUCOUS MEMBRANE OF THE BODY OF THE UTERUS. (The third day of menstruation). *M*, Mucous layer. *M′*, Muscular layer. *C*, Cavity. (After *Léopold.*)

The vessels disappear, the hypertrophied cells vanish, their granular contour is reabsorbed, and the whole mass, which enters little by little into the tissue of the ovary, is finally reduced to a small lardaceous, yellowish tubercle, and in other cases to a simple colorless fibrous core, like an old cicatrix. Finally the corpus luteum disappears." (Longet.)

According to Pouchet and Raciborski, the yellow coloration is due to an extravasation, or to an imbibition similar to that which is produced in ecchymosis. According to Longet and Coste it is caused by the common tint of the granules contained in the cells.

We see that these authors admit the existence of two layers in the vesicle of de Graaf. To-day, modern anatomists only grant a single layer, but its reduplication and the union of these folds are admitted by all. Hence the opinion of Longet is nearly exact.

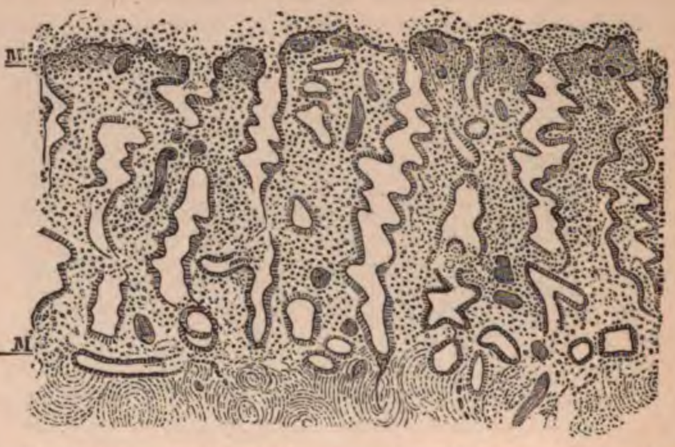


FIG. 66.—MUCOUS MEMBRANE OF BODY OF UTERUS, THIRD DAY OF MENSTRUATION. *M, M'*, Mucous and muscular layers. (*Léopold*.)

According to Robin, the thickening of the membrane of the ovisac is due to the increase of the amorphous matter that it contains, and especially to a deposit of a large quantity of fat, and to an enormous increase in number and volume of the true cells of the ovisac. At the same time, the vessels and connective tissue increase, and we can show the presence of pigment, and of crystals of hematoidin, the last vestiges of the blood in the vesicle at the moment of rupture. When the corpora lutea are passing away, an inverse phenomenon takes place: the cells are atrophied and disappear by absorption, as well as the amorphous matter that unites them. The cicatrix is now only represented by laminated tissue, which blends with the ovarian tissue. Yet we may still find fatty vesicles or free fat, and amorphous or crystalline coloring matter. (Robin.)

If we no longer keep the old distinction between true and false corpora lutea, we must nevertheless distinguish two kinds. Those which result from the cicatrization of a follicle, after the ejection of the ovum without being followed by conception, and those which are followed by conception and gestation: corpora lutea of menstruation, and corpora lutea of pregnancy.

While, according to Coste, the evolution of the first, the corpora lutea of menstruation, requires thirty or forty days, ten days of increase, and from twenty to thirty for definite cicatrization; that of the corpora lutea of pregnancy, the old true corpora lutea, requires a much longer time. Much longer, although of the same nature, it attains its maximum between the thirtieth and fortieth day after conception. There is then an interval which lasts till towards the close of the third month; from this point begins the period of atrophy which only ends after delivery, for the corpus luteum still remains, in the first days that follow delivery, as a small tubercle from .31 to .39 of an inch in diameter. The disappearance is not complete until a month after delivery. Unfortunately we have had, during our stay at the Clinic and the epidemics of puerperal fever, only too many occasions of verifying the truth of this assertion of Coste.

Sometimes, however, the evolution is more rapid, and Coste cites a case where the absorption was complete in a woman who died during the eighth month of pregnancy.

Causes of the Fall of the Ovum.—If spontaneity of formation, of increase, of maturation, and of shedding of the ova was admitted for all animals, it was not the same for man, and the mammifers. It was thought that in them, the formation of the ovum dated only from the moment when the seminal fluid united with an unknown female element contained in the ovaries. (Longet.)

When de Baer discovered the ovum, he greatly disturbed this hypothesis of an exception in favor of man and the mammifers. The researches of Coste, Négrier, Douvernay, Raciborski, Bishoff and Courty, showed definitely that the phenomenon of spontaneous ovulation exists in woman as in other species of animals, without the intervention of the male. But, though this intervention is not necessary to determine the rupture of the follicles, and the ejection of the ovum, it does not follow that it has no influence on these two physiological phenomena, when it is exercised at an opportune time. Thus, Coste has shown that the constant presence of the male hastens the return of heat. Again, copulation, without being the essential cause of the ripening of ova, precipitates this phenomenon, or prevents it from proving abortive.

The rupture of the follicle of de Graaf results from congestion and the accumulation of fluid in the follicle, which distends it beyond limit and makes it burst. Hence it is evident that coition and the semen, acting as stimuli, may augment this congestion, revive it when it abates or diminishes, and thus become the efficient cause of the rupture. Spontaneous ovulation, nevertheless, is the most frequent, and it takes place at intervals, which vary in the different species, but are generally fixed for each.

While in the animal species this epoch corresponds to heat, in woman these phenomenà correspond to what is called the catamenial epoch, menstruation.

In woman, as in animals, heat, menstruation, is the natural time for the maturation of ova, and therefore the most favorable for conception.

MENSTRUATION.

Menstruation (menstrual flow, menses, catamenia, flow, catamenial flow, etc.), is a function of the female organism, a temporary and intermitting function, that is made manifest by two kinds of phenomena: internal phenomena, the evolution of the vesicle of de Graaf, and the formation of the corpora lutea; external phenomena, of which the most apparent is a bloody flow through the genital passages. Temporary, for it exists only from puberty to the menopause, this function is intermittent, and we may say periodic, for it is manifested by a series of phenomena which are reproduced nearly every month. This bloody discharge is only the consequence of the hyperæmia which is produced in the whole genital system of women: ovary, tubes, uterus and broad ligaments.

According to Richet, the venous system of the broad ligament plays a considerable part in this function, and the plexus which the veins form in these ligaments, may be tumefied enough to become appreciable to vaginal touch, during the menstrual period. We have already seen that according to Richet, these veins become varicose, may even burst in certain cases and become the origin of hematoceles, which are above all observed at the time of the catamenia.

Anatomical Modifications of the Genital System produced by Menstruation.

The anatomical phenomena which occur during menstruation are not limited to the ovary. The whole genital apparatus participates in the vital activity then produced, and there occurs, in the vascular portions especially, a series of modifications which have been carefully studied by Coste, Ch. Robin, Richet, Rouget and Kobelt. Rouget has shown that the ovary, the tube, the uterus and their vessels, are surrounded by a system of muscular fibres which, under the influence of the ovarian nisus, contract, and, compressing the venous plexus, retard the flow of blood. The flow of blood being retarded, the circulation is, in turn impeded; hence, increase of tension in the capillaries and other vessels; hence, arrest of blood in the uterine tissue, exaggerated congestion, and, as the final phenomenon, the rupture of the capillaries, and appearance of the menstrual flow.

The uterus is, next to the ovary, most influenced by the menstrual function. Under the influence of congestion its volume increases a quarter, a third, and sometimes more. It thus becomes easily accessible through the abdominal wall. According to Rouget, the uterine tissue, filled with blood, suffers a true erection. The vertical diameter of the uterine cavity increases from .19 to .39 of an inch according to Richet. Its fibres become more red, more supple, and more spongy.

The cervix becomes larger, softer, and violet colored. The external os opens slightly; the cervix seems to lengthen and to become more accessible to the finger of the investigator. The internal os opens to give passage to the fluids from the cavity of the body of the uterus.

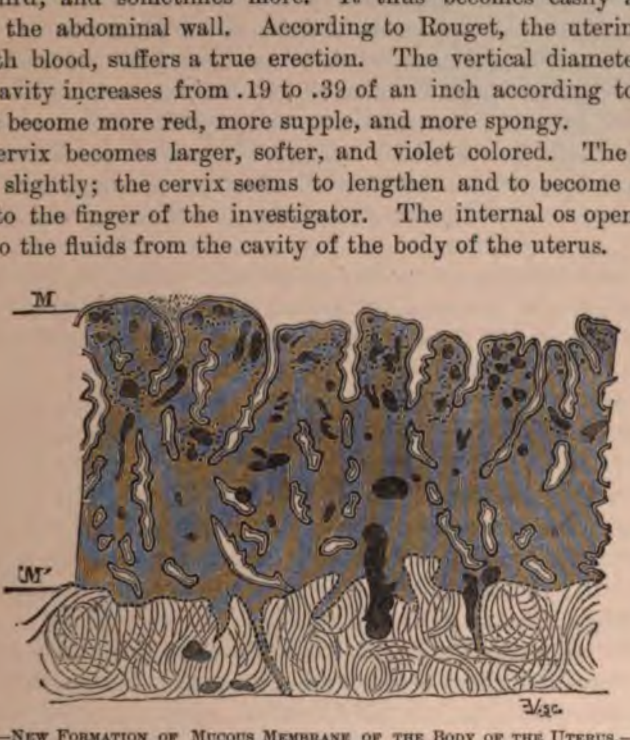


FIG. 67.—NEW FORMATION OF MUCOUS MEMBRANE OF THE BODY OF THE UTERUS.—From eight to nine days after the beginning of the last menstruation. (After *Léopold*.)

The mucous membrane of the uterine cavity becomes thicker, and is colored a deep reddish-brown. It becomes folded and mamillated. The hypertrophied glands become the seat of an abundant secretion, the subepithelial vascular net-work of Robin becomes more apparent, surrounds the enlarged orifices of the glands, and thus gives the mucous membrane the appearance of a sieve. (See Figs. 65 and 66). Soon the epithelium which covers it loosens, the capillaries, ceasing to be supported, yield to the pressure of the blood, and burst in a number of small crevices, just as the pituitary mucous membrane bursts in epistaxis, and the blood flows through these innumerable microscopic openings.

The menstrual fluid is then composed of blood, the products of mucous secretion and epithelial cells.

It is the mucous membrane of the body, and especially of the fundus, that furnishes the catamenial discharge. The mucous membrane of the cervix scarcely participates. Its vessels are more resisting and do not burst; they merely dilate. Thus, the discharge that proceeds from the cervix is purely mucous, and only mixes with that which comes from the cavity of the body.

According to John Williams and Léopold, the modifications of the mucous membrane are analogous to those which occur during pregnancy and delivery. The phenomena which we have just mentioned, are accompanied by a true degeneration of the mucous membrane, which exfoliates cell by cell. But, according to Léopold, these phenomena are limited to the most superficial layer of the mucous membrane, and its glands, and they do not occur until after the appearance of the discharge, and hence could not be its cause, as Kundrat and Engelman thought.

The tubes participate in this hyperæmia, their vessels are injected, their walls thicken, and they also suffer a sort of erection which brings them toward the ovary. Their canal is sometimes filled with blood, which augments the menstrual flow.

As for the broad ligaments, the same phenomena of congestion occur in the uterine and sub-ovarian plexus which they contain. Hence, as Richet said, the possibility of feeling the projections, due to the great development of these plexuses.

The vagina becomes redder, darker, warmer, its circulation more active, the mucous membrane slightly swollen, and its secretion has more or less odor, according to the woman. The women feel torpid, heavy, and complain of fatigue, and an unusual lassitude.

Even the vulva seems to become tumefied, and is sometimes the seat of slight pruritus; urination becomes more frequent; in a word, the whole genital system participates in this function.

The breasts swell, become harder, more sensitive, sometimes even painful.

Besides the genital organs, the catamenial epoch reacts upon the rest of the economy, and it is not rare to see women experience a little flatulence, accompanied with diarrhœa; taken with neuralgic pains, headache, tonsillar or herpetic angina, swelling of the thyroid gland, transitory congestions and cutaneous eruptions, especially on the face. All this is accompanied by a feeling of sickness, general fatigue, which is shown by a want of calmness and repose, with an excitement and a nervous susceptibility which reacts upon the moral and intellectual condition. In some cases even a slight febrile movement occurs. We have seen that this state is in intimate relation to the evolution of a Graafian vesicle. Women without ovaries do not have the menstrual discharge. But what is the precise moment of the maturation of the ovum? It is impossible to determine, for this maturation varies with the individual and with circumstances. Rouget's researches show, however, that it is generally in the last days of the menses.

In the last few years, however, some writers oppose this view as too absolute, and even go so far as to deny the correlation between ovulation and menstruation.

It is not very rare to find, in young girls, a great number of Graafian follicles in process of development, and even in an apparent state of maturity. But, in them, the vesicle does not rupture, and these developed follicles disappear by simple regression. But some writers go still further. Giraudet de Tours, Beigel, Paul Mundé, and de Sinety, have tried to show, that, on the one hand, spontaneous ovulation may take place without the menstrual discharge, and that, on the other hand, the menstrual flow may take place without ovulation.

Beigel, who among the first was against the old theory, cites the case of Ashwell, who, in three autopsies on women who died during the menses, found on the ovaries no traces of corpora lutea, or of the rupture of the vesicle of de Graaf. To an analogous case of Paget's, we may add Kölliker's ten cases, those of Girwood, Coste, Giraudet, Godard, and Gubler, who, in a great number of acute diseases, observed bloody discharges analogous to the menses, but independent of ovulation, and which he called uterine epistaxis.

Beigel then calls attention to the more singular cases, in which there had been an extirpation of the two ovaries, and a continuation of menstruation; those of Clay, Beigel, Peaslee, Koeberlé and Storer; we may add those of Atlee, Spencer Wells, Baker-Brown, Goodeman, Lefort, de Tessier, etc. Ormières (1880) collected all the cases of menstruation after simple and double ovariotomy and hysterectomy.

From another point of view, in cases of congenital absence of the uterus, if the ovaries are intact, there is ovulation and the production of corpora lutea without menstruation. (Oldham.)

Gubler cites cases in which ovulation preceded menstruation by several years.

De Sinety found traces of recent corpora lutea in women whose menses had disappeared for some time on account of disease.

Finally, Tarnier and Chantreuil mention the cases of married women, who became pregnant without the reappearance of the menses, and the rarer cases where women conceive after the menopause.

According to Beigel these facts are conclusive; but the researches of Gusserow and Waldeyer show that in certain cases there is in the pedicle of certain ovarian cysts a quantity of ovarian tissue, and that even here are found traces of corpora lutea. Nevertheless some of these facts seem indisputable. Beigel does not hesitate to conclude from them that menstruation is absolutely independent of ovulation. For him, menstruation ought to be considered as a genital impulse, repeated from time to time, and accompanied by an afflux of blood, and a great distension of the capillary vessels of the uterine mucous membrane, and very probably of the tubes, and terminating by a bloody discharge coming from these capillaries. The part taken by the ovaries would then be as passive as that of the uterus, the vagina and the tubes.

The theory of Gendrin, Négrier, Bishoff and Coste, is, nevertheless, as yet the classic theory.

[In many women who, apparently, do not menstruate, and yet certainly do ovulate, close inquiry will reveal the fact that, while they do not have a periodic red discharge, they do have a periodic white, the so-called white menses. These cases are not rare.—Ed.]

First Appearance of the Menses.

If, in a number of young girls, the first menstrual hemorrhage appears suddenly, this is far from being the case always. This hemorrhage is usually preceded by malaise and local and general troubles, which may reappear for several months, until menstruation is definitely established. The child, which is to become a woman, each month experiences a weight in the hypo-gastrium, colic and swelling of the breasts; at the vulva there appears white mucous discharges, but it is not until after some time that the true menstrual discharge appears. The first appearance of this discharge is subject to the influence of a certain number of conditions, which we will successively pass in review.

Among these conditions is one that Raciborski called the genital sense, and which he defines as: the greater or less vigor that nature displays in the development of the vesicles of de Graaf. If the menses generally appear in young girls from the twelfth to the sixteenth year, it is not rare to find a much earlier appearance. There are even cases where they have not appeared until the twentieth, twenty-second and even the twenty-fifth year. All writers have shown that very great differences exist in the development of the ovaries in the fœtus, and these differences are accentuated with age, thus impressing corresponding changes upon the menstrual function. Raciborski cites a great number of facts that justify this assertion. Among these cases, there is one in which the ovarian activity seemed to begin from the very first years, not to say the first months, after birth, and it is sufficient to recall the cases of Dezeimeris, Comarmond (de Lyon), Le Beau, d'Outrepont, and Suservind. These cases, which Raciborski characterizes as anomalies, show clearly that, in certain individuals, this genital power is much more developed than in others, and that the menses appear much sooner. Besides these cases of precocious menstruation, there are, on the contrary, women in whom menstruation is delayed, and does not appear for the first time until the twentieth to the twenty-sixth year. There are other cases in which the menses never occur. In these women, the absence of the menses does not absolutely exclude ovarian evolution, hence they may become pregnant, but they are much less apt to be fecundated than women in whom the menses are normal and regular.

Next to the influence of the genital sense is that exercised by heredity and race. Heredity, the influence of which is felt in so many different ways, can not fail to exercise its action upon menstruation, and it shows itself in some cases in a most remarkable way. The cases of Courty prove this sufficiently. Not less is the influence due to race. In the East Indians the menses appear very early, but in young girls born in India of English parents they are retarded. The researches of Schukitz, which were carried on in the different provinces of Austria, where the races are diverse, establish a difference of two years between the time of appearance of the menses in the Hungarians, and the people of other provinces. From this point of view, then, the Magyar race is more precocious than the German and Sclavic races. Lagneau tried to explain the differences between Paris and Strasbourg by the mixture of the two races which form the population of the Lower Rhine. Finally, Raciborski has shown that among the Jews of Poland, who intermarry, and where, consequently, the race is not mixed, the menses appear earlier than in other women. In the latter they appear, on an average, at fifteen years and nine months, while in the Jewesses they appear at fifteen years, five months, and twenty-six days.

The influence of latitude and climate is evident for widely different climates, and has been exaggerated by a number of writers. We may say in a general way that menstruation is more precocious as we near the Equator, more backward as we near the cold countries. Tarnier and Chantreuil, set this epoch at between twelve and eighteen years for temperate climates, from eleven to fifteen for hot climates, and from thirteen to twenty-one for cold climates. The average temperature is also of importance. Under the influence of heat the number of precocious menstruations increases, and that of tardy menstruations decreases. The contrary happens under the influence of cold.

City life or country life, the method of education, and the diet, all affect the period of the first menstruation. Women in cities menstruate sooner than women in the country, women of the working class before children of the wealthy; but great allowance must be made for the demoralization existing in the work-shops and factories, which, by developing the genital instinct, leads to precocity in the menstrual function. On the other hand, insufficiency or bad quality of food often retards puberty, while a rich diet, and a life of luxury and pleasure, hasten its appearance.

A curious phenomenon is called the vicarious menstruation. This may occur in two ways: in one, the menstrual discharge takes place, but in a minimum degree, and, at the same time, a hemorrhage from some other organ than the uterus is produced. This is principally from the lungs, pituitary body, or intestinal canal, or in the sub-cutanous cellular tissue, (the breasts, of which we have had an example). These hemorrhages form the supplementary menses. In the other instance, there is no uterine hemorrhage, and it is replaced by a bloody discharge from the lungs, intestine, nose, mouth, surface of a sore, of an erectile tumor, or the skin. (Jacquemier). Courty says that in these cases this vicarious menstruation stops if pregnancy occurs; appearing again after confinement, thus acting like the true menses.

Sometimes the menstrual hemorrhage takes place on the internal surface of the uterus, but the blood does not flow to the exterior, being retained in the interior of the uterine cavity or the vagina, by a partition of the vagina, an imperforate hymen, in a word a defect of formation of the uterus, cervix, the vagina, or of the vulva. This phenomenon, which may cause grave results, is called retention of the menses. In other cases, the flow occurs accompanied by extreme suffering, and the woman ejects a true membranous sac, or at least shreds of membranes, the microscopic examination of which demonstrates it to be exfoliated uterine mucosa, really degenerated as at confinement. This form of menstruation is called pseudo-membranous dysmenorrhœa.

Characteristics of the Menstrual Blood.

The quantity of blood lost by women at each menstrual period is extremely variable; thus the figures given by writers vary from eighteen ounces to three ounces. These differences are explained not only by individual variations, but also by the difficulty of estimating the exact quantity of blood contained in the menstrual flow, which is always mixed with the mucous secretions of the vagina and uterus. Besides, exactness is still more difficult, because, although there are women who only lose a few ounces of blood, there are others who lose upwards of eighteen ounces. This hemorrhage, which certainly would be excessive for some, is on the contrary admirably borne by others, and does not affect their health. Nevertheless, the average can be placed at from three to six ounces. The quantity of blood lost varies in the same woman, according to her diet, health, exercise, abuse of the sexual relation, condition of health or sickness, and consequently there is nothing fixed. There are three stages of the menstrual discharge, corresponding exactly with the anatomical changes of the uterine mucous membrane. At the start, the glandular activity predominates; the natural consequence of this is that mucous discharges predominate, the fluid is slimy, with a penetrating odor; it is more or less colored, either a light or dark red, and, under the microscope, numerous epithelial cells are found, which come from the mucous membrane of the uterus and vagina, and a large quantity of mucous globules coming from the glands, the whole mixed with red globules more or less numerous and unchanged. In the second stage, the blood is almost pure. The discharge is then liquid, slightly slimy, and deep red like venous blood. Finally the third stage or period of decrease arrives. The diminution in the number of blood globules, the increase of the mucous secretion, restores its first character with this difference, that the epithelial elements are very few.

It is not rare to see women, in whom, after this third stage, a new discharge of almost pure blood follows; only this discharge ordinarily lasts but twenty-four hours, and is followed by a purely mucous discharge, which may last thirty-six or forty-eight hours.

Some writers have claimed that menstrual blood differs from ordinary blood in its viscosity and lack of coagulability, and wish to make a diagnostic sign of it from the blood that accompanies an abortion. This is absolutely a wrong statement, for there are a large number of women who discharge clots at the time of their menses; and we would fall into serious error if we should consider the presence of clots in the hemorrhage coming from the genital organs as an indication of a miscarriage. The menstrual blood was thought for a long time to be a poisonous fluid, having an injurious effect on living things, men, animals, and plants. This is erroneous, of course. Chemical analysis has shown that the menstrual blood does not differ greatly from ordinary blood. But, although the menstrual blood is not poisonous, it is not the less true that the mucous element which it contains has at times irritating and injurious qualities, which cause a peculiar form of chronic inflammation of the urethra, which has been well studied by Diday (of Lyons). If these accidents can happen in our temperate climate, they can, with more reason, occur in hot climates; hence the wisdom of the law of Moses which forbade cohabitation with woman during the menstrual period.

Progress and Duration of the Menses.

The chief characteristic of the menses is their periodicity, but, although they are periodic, the interval between the periods is not the same in all cases; it can even vary in the same woman. In most cases, this interval is from twenty-five to thirty days, but there are some women in whom the menses are ahead of or behind an exact number of days. According to Paul Dubois and Courty, the interval should be a solar month of thirty days and not a lunar month of twenty-eight days; but it is useless to try to fix an exact date, for irregularities in return are very frequent. They are the rule at the commencement of puberty, and at the menopause, and the menses very frequently change from the effects of marriage and repeated pregnancy. In some women, in the interval between the two periods, toward the middle of the intermenstrual time, there occur, unexpectedly, signs of uterine and ovarian hyperemia, accompanied, or not, by a slight bloody discharge, called the supernumerary menses.

Although the menses vary greatly in periodicity, there are still greater variations when we wish to determine the duration of the menstrual discharge. Ordinarily it is from three to six days, but exceptions are frequent.

The following is a table (from Paul Dubois) showing the duration of the menstrual period in 600 women:

Menses lasting 1 day	11	Menses lasting 7 days	1
" " 2 "	32	" " 8 "	115
" " 3 "	104	" " 9 "	4
" " 4 "	84	" " 10 "	2
" " 5 "	63	" " 12 "	2
" " 6 "	62	" irregular	120

According to this table the largest number of women menstruate for eight days, but Paul Dubois says, with truth, that by eight days the women really mean seven, or one week.

Physiological Characteristics of the Menses.

This is a question which it is yet actually impossible to answer. The menstrual flow was considered by the ancients as a means of unloading the organism, from month to month, of the surplus of blood; this explanation, which is based on the old theory of plethora, is not admissible to-day, for it has been proved that, during pregnancy, not only is there no plethora but that there is anæmia. But, if the menstrual flow is not intended to unload the organism of surplus blood, it has another object according to Andral and Gavarret. These writers say, that the quantity of carbonic acid exhaled by the lungs increases in women until puberty, from this time on it diminishes, increasing again after the menopause. The suspension of the menses, which is determined by pregnancy, nursing, amenorrhoea, etc., restores the increase of carbonic acid as after the menopause. The purpose of the menstrual flow would then be to increase in women the phenomena of combustion; it would therefore be a kind of natural emunctory.

Although the menses are periodical and regular, there are certain causes which, for the time being, suspend them during the active period of the genital system. Some of these causes are physiological, as pregnancy and confinement; others are of a pathological nature.

Pregnancy almost always stops the menses, and cases of women menstruating during pregnancy should be absolutely rejected, unless they are admitted as entirely exceptional. The menses commence again about six or seven weeks after confinement, but this is not certain, for they are not rarely delayed until the end of the second and even of the third month.

It is lactation which stops the menses, at least during the first months. The return of the menses in the wet-nurse is generally indicated by the bad quality of the milk. But, in the wet-nurse, the stopping of the menses does not interfere with ovulation, and this is proved by the remarkable number of women who become pregnant while nursing. Besides these physiological causes, there are others which induce the cessation of the menses from a pathological stand-point; such as, quick and violent emotions, cold, hemorrhage and, finally, the essential fevers. These last, it is true, are not always active in causing the cessation of menstruation, but they have a remarkable influence on it; thus, in some cases they increase the bloody discharge; in others, and more frequently, diminish or even entirely stop it.

MENOPAUSE—DURATION OF THE ACTIVITY OF THE GENITAL ORGANS.

Even as we have seen that puberty causes in a young girl a series of external phenomena which are the evidence of changes taking place in the internal genital organs, in the same way the menopause, critical age, or change of life, shows itself by a series of changes which indicate the cessation of the active period of woman's existence.

The menopause is the time when menstruation ceases. No definite time can be fixed, the menopause taking place in some women at thirty-five, thirty, or even twenty-eight years, in some the menses occur up to sixty, sixty-five and sixty-eight years. I once saw a very curious case of a woman, in whom the menses stopped at forty-eight years with all the phenomena of the menopause, and in whom at sixty, a dozen years after, they reappeared for two years, the periods having the same regularity and the same intensity as at her prime. This tardy reappearance had no effect on her general and local health, and the last appearance at sixty-two years and two months took place without injuring her health. This woman died at seventy-two years of age of pneumonia. But the extreme figures, from thirty and sixty to eighty years, are wholly exceptional, and generally it is between forty-five and fifty that the critical age occurs.

According to statistics of various authors, the ordinary age in Paris is fifty years. The average duration of genital life in women is, then, from thirty to thirty-one years. We ought to add that, the early or late cessation of menstruation, does not necessarily prove that ovulation suffers the same cessation, or the same persistence, for we know that the two phenomena, hemorrhage and follicular development, are not necessarily dependent on each other. (Depaul). We find the same influences, inversely, as in puberty, but less marked; and we must not conclude that women who menstruate early are those in whom the menses stop the soonest. The contrary would rather seem to be true. Lancereaux said that alcohol caused an early atrophy of the ovaries, especially in their glandular part.

In general, the menopause does not take place suddenly. It commences by irregularities in the menstrual flow. Soon this ceases for several months, followed by a real flow; then there are variations in the duration, quality and quantity. At the same time various general ailments appear, congestions of different organs: the head, the lungs, and, above all, the liver. The genital organs, on the contrary, seem in some cases to be, for the time, especially active. The genital sense seems to awake, and as there still survives, in general, some development of the breasts and abdomen, certain women believe themselves to be pregnant, (a nervous, false pregnancy), all the symptoms of which they think they have.

These phenomena are accompanied by more special ones in the genital organs, which are expressed by one word, atrophy. The ovaries, first, waste rapidly, their vascularization diminishes, and they are changed into a true fibrous tissue. The uterus, the same as the ovaries, becomes atrophied, its arteries are incrusted with calcareous matter, its veins become varicose, the cervix loses its length, decreases in size, sometimes shrinking entirely away.

Even the external genital organs change; the labia majora dry up and sink down, the vulva has a venous tinge, the hair of the pubes whitens and falls, the breasts become flabby, in a word the woman loses her sex—habits, desires and functions, approaching those of a man. (Depaul.)

The name critical age, given to the menopause, seems to indicate that the menopause predisposes to certain diseases, particularly organic diseases of the genital apparatus. This opinion is considerably exaggerated, as statistics prove, but it is not the less true that this time is marked in woman by the appearance of various affections generally unimportant, as hemorrhoids, bleedings, cutaneous eruptions, etc.

CHAPTER II.

FECUNDATION.

FECUNDATION, or impregnation, is the result of the combination of the male and female elements, the semen and the ovum. To make this combination requires the connection of the two sexes by copulation.

COPULATION.

Copulation, or coition, consists of the union of the two sexes, which should be preceded in man by erection of the penis, the placing of the glans in the genital organs, and the emission of semen or fecundating fluid, which is thus carried directly into the genital organs. It is this final phenomenon of emission which is followed by the progression of the semen into the genitals, the fecundating liquid thus seeking the ovum, which has been deposited in the tube.

In woman, copulation is a much more passive act than in man. It consists of the reception of the male organ, accompanied by the erection of the clitoris and bulbs of the vagina, but without emission properly so-called, it being only an exaggerated secretion of the vulvar and vaginal glands, and particularly of the vulvo-vaginal glands.

In one sex as well as in the other, the act is preceded by desire, the sexual appetite, and is accompanied by voluptuous sensations, generally greater in man than in woman, and which are intended to insure the accomplishment of a function on which the reproduction of our kind depends. But, although in man this feeling is as absolute as possible, in woman it is much less clear or developes later. Besides, it is not necessary to fecundation, and it is not rare to see mothers of families in whom this voluptuous sensation has never been present.

Again, although in man there is always an emission of fecundating liquid, ovulation comes but once a month in woman. Copulation is therefore not always followed by fecundation. The voluptuous sensation, in its turn, is not necessary to fecundation, and examples of women who have been impregnated while sleeping from the effects of alcohol or chloroform, and through artificial fecundation, prove that the woman is really passive in the act of copulation. Her active part is confined to the emission of the ovum and its progress through the tube. The final union of this ovum and the semen forms in reality fecundation.

Occasionally, on the contrary, the first conjugal attempts occasion, especially in nervous women, vulvar and vaginal pains, with a painful spasm of the contractile fibres of the vagina, and of its constrictor muscle, which forms what is called vaginismus. This relatively frequent occurrence interferes with sexual intercourse, and thus removes all possibility of copulation.

In the human race, it is about the time of puberty that the desire for sexual connection commences, reaching its maximum in the adult, disappearing little by little in old age, and it is always greater in man than in woman. However, contrary to what has been said of man, that with age the sexual desire gradually lessens, it is not rare towards the age of the menopause and the years that follow to see some women, until then cold, become all at once extremely eager, and desire conjugal connection, scarcely tolerated before. Dr. Géneau de Mussy cites a number of intances of this nature. For my part, I have seen two cases, one, a woman of fifty-five years, the mother of a family, who, afflicted by this appetite, absolutely isolated herself, seeking in art to find a remedy for what she rightly called a phenomenon as useless as unreasonable.

We have studied the ovum or female organism; let us now see what elements compose the fecundating fluid: the semen.

THE SEMEN.

The semen is secreted by the testicles, accumulated in the seminal vesicles, and thrown into the urethra by the ejaculatory ducts. From there it is carried directly into the genital organs of the female by the emission which finishes coition.

It is a white, viscous liquid, with a density much greater than water, and the consistency of which increases by continence. By desiccation it stiffens when it is deposited, and it has a peculiar odor like the raspings of bone, or the flower of the chestnut-tree. Some authors hold that this odor does not really belong to it, but is due to the mixture of liquids from the glandular apparatus of the prostate and urethra.

This liquid consists of water, extractive matters, and phosphate and chlorhydrate of lime and soda, but it is characterized by the presence of peculiar organisms discovered under the microscope.

When the semen is examined with the microscope, there are found pavement epithelial cells, cylindrical cells, spherical nuclei, leucocytes, crystals of magnesium phosphate, special bodies called spermatozoids or spermatozoa, or zoospermes, according as they are considered as belonging to the animal or vegetable kingdom.

These spermatozoa were discovered in 1667 by Louis Hamm, a medical student, and were especially studied by Leuwenhoeck, who wrongly claims the honor of their discovery. They are animated filaments with an action of their own, and form the essential fecundating part of the semen. They are about $\frac{1}{600}$th of an inch in length, formed like the tadpole of the frog, and have three parts, head, body, and tail. (Fig. 68.)

The head is the smallest part. Its length is about one twentieth of the length of the tail.

The body is small, oval, and flat, immediately behind the head, with which it is almost blended.

The tail is filiform, thicker at its beginning, becoming almost imperceptible at its end.

Ordinarily, plainly separated from the body and the head, it is sometimes covered by a little projecting pad, which is only the remains of the nucleus in which the spermatozoid is developed. Godard and Liègeois discovered besides these normal spermatozoids, another variety with a smaller head.

These little bodies are animated by very rapid movements, and can cover a distance nearly equal to the length of their bodies in a second. These movements generally stop in about twenty-four hours after the semen is exposed to the air. Placed in a closed jar the spermatozoids still move at the end of fifty to sixty hours, and, deposited in the genital organs of a woman, seem to keep an extraordinary vitality, for Percy is said to have found them alive on the cervix of the uterus of a woman eight days after the last coition. This vitality lasts even after the death of the individual, for Godard proved it seventy-two hours after death by execution. They are more or less abundant according to the individual, and the fecundating property of the semen seems to be much more active when they are more numerous and animated by more movements. But their absence in the semen does not fatally involve impotence, as Casper, Hirtz and Montegazza believed. The individual, in this case, can accomplish coition, but the coition is fatally non-fecundating. High temperature stops the movements of the spermatozoids, but these movements can be reproduced when the temperature is brought to 98.2° F. They are definitely destroyed by the electric spark, alcohol, acids or alkaline fluids too highly

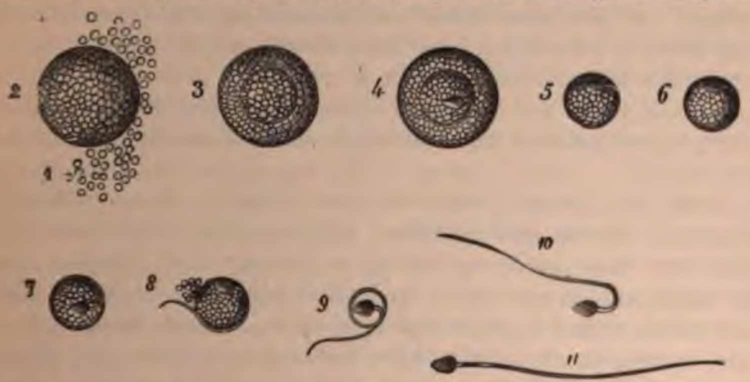


FIG. 68.—SPERMATOZOA: DIFFERENT PHASES OF THEIR DEVELOPMENT. (From *Godard*).—1, Spermatic granules. 2 to 4, Mother cells. 5 to 9, Daughter cells. 10, 11, Formation of the spermatozoön and its development to a perfect state.

concentrated. The alkaline or acid state, exaggerated by the vaginal or uterine secretions again acts on them fatally; the menstrual discharge on the contrary increases the movements.

Up to sixteen or seventeen years the semen does not contain spermatozoids, but after this age they are always found in normal semen; it is only in very old men that they are no longer found, for the researches of Duplay and Dieu show that in old men of seventy-five or eighty years they are in most cases still found.

The spermatozoids were considered as animalcules by Leuwenhoeck Haller, Spallanzani, Gleichen, Hill, Czermak, Valentin, Schwann, Pouchet and Pajot; but to-day they are regarded, not as animalcules, but as cellular elements. Kölliker was the first to demonstrate that the spermatozoids are not animalcules, and that they develop in a cell, and at the expense of the nucleus. Since then, Robin, Reichert, Leuckart, Ackermann, Funke, Henle and Godard have adopted the theory of Kölliker, and it was only after 1864 that the question of spermatogenesis entered a new phase. At that time, Sertoli discovered in the seminiferous ducts of the rat peculiar cells with a large base, divided into lobes at their apex, and provided with a nucleus with a cylindrical prolongation. Since then, in 1875, Ebner and Neumann demonstrated that the spermatozoids develop at the expense of these prolongations, and the small lobes of the cells of Sertoli.

In 1800, Dr. Planteau reviewed the different theories that had existed, and showed that Kölliker, studying the seminiferous tubes, proved that they are composed of a thin layer of laminar tissue, below which was an amorphous and absolutely hyaline layer, on which, in the adult, rested a polyhedral epithelium. These tubes end in a cœcum, towards the periphery of the testicles, having at great intervals small diverticuli, which also end in a cœcum, in which are found the peculiar elements described by Robin under the name of male ova. Exteriorly, and laterally, Kölliker describes polygonal cells, of an epithelial appearance, which flatten each other, and which enclose a nucleus with a nucleolus. Within this first layer is a polyhedral epithelium and large cells with many nuclei.

Pouchet and Tourneux consider the testicular epithelium as formed: 1st. of special cells, which they called spermatoblasts; 2d. of polyhedral cells interspersed among the spermatoblasts.

The spermatoblasts are elements presenting a flattened base, of a regular and polygonal shape, which is directly applied to the wall of the seminiferous tubes. This base, which presents a large nucleus, is surmounted by a narrow portion, the swollen extremity of which is directed towards the lumen of the seminiferous tube. This extremity is divided into lobes which give birth to the spermatozoids. All the bases touch at the wall of the tube, and form, by their union, a very regular mosaic.

According to Kōlliker the seminiferous tubes contain three kinds of cellular elements: 1st. cells with a single nucleus, which he considers as epithelial. 2d. Larger or smaller cells, containing a variable number of nuclei, and which he called mother cells. 3d. Vesicular elements, also containing nuclei, which he called spermatic cysts. In the mass of these nuclei, contained either in the mother cells or in the cysts, appears a thickening which forms the head and body of the spermatozoid. Attached to this thickening is a rolled-up filament, a filament that is nothing else than the tail. The body of the spermatic filaments comes from the nuclei of the seminal cell; the filaments spring from these nuclei themselves. The nucleus first lengthens at its poles into a delicate tube, which is then perforated by an opening at its extremity. The contents of the nucleus form in the interior of the tube a conical corpuscle from which the filament springs.

According to Reichert, the spermatozoids proceed from vesicles that develop at the bottom of the seminiferous canals. These cells have a nucleus. The contents of these cells become granular like the vitellus of the female ovum, then segment into a mass of cells, each of which is to form a spermatozoid. At one of the poles of the cell appears a prolongation, the tail: the cell itself forms the head.

Robin, who adopted Reichert's ideas, compares the mother-cell of Reichert to a female ovum, and calls it the male ovum.

Godard shows that the spermatozoids come into existence at the expense of two elements contained in the seminiferous canals: the mother-cells and smaller cells, called daughter-cells. The granulations which compose the latter coalesce at one point of the cell, which becomes more opaque, to form the head, then the other granules coalesce to form the tail. The spermatozoid, which is at first rolled up in the cell, becomes free by rupture of this latter, the tail then unrolls and the movements soon begin. This is the endogenetic theory. (Fig. 68).

The second theory is the theory of exogenetic formation.

We have seen that, according to Pouchet and Tourneux, the spermatoblasts are elements presenting a flattened base, of a regular, polygonal shape, and directly applied to the wall of the seminiferous tube. This base has a large nucleus, and is surmounted by a reduced portion, the enlarged extremity of which points towards the lumen of the seminiferous tube. This extremity divides into lobes from which spring the spermatozoids.

According to Balbiani, the elements that cover the interior of the tubuli seminiferi form four concentric zones:

1st. A layer of flattened polygonal cells, which are regular and applied directly to the wall of the tube.

2d. A layer of small round and granular cells.

3d. A layer of large round or pyriform cells.

4th. A zone of fascia of spermatozoids, which are free within the middle of the tube, and which are placed in radiating lines.

The small cells first appear as buds in the large polygonal cells, and as soon as some cells are thus developed, others proceed from the first by segmentation, and there are thus formed groups of cells, more or less numerous, and always connected by their prolongations to the mother-cell. Then the pedicles lengthen, the cells increase in volume, and it is thus that the groups of large, round cells are formed. Finally, when these latter have arrived at a certain degree of development, the mother-cell, or polygonal cell, sends out its prolongation in the shape of a small column; the groups of spermatoblasts are thus lifted up, and taken towards the lumen of the canalicule.

Finally, according to Duval, the spermatozoid develops in the following manner:

There develops in the spermatoblasts a globule of an homogeneous aspect, which is highly refractive and colored carmine. It is entirely independent of the nucleus, and is situated in the pedicle which unites, in the shape of a racket, the spermatoblasts to the mother-cell. At first, it is entirely enveloped in the protoplasm, but later, it escapes, becomes free, and, at the same time, is transformed into the head of the spermatozoid. At the same time that the head forms, the caudal filament appears at the other pole of the spermatoblasts in the protoplasm. This soon lengthens and emerges from the cell.

The middle segment also develops by differentiation of the protoplasm.

At the free extremity of the lengthened spermatoblasts, which are now provided with their nuclei, there forms a pencil of vibratile ciliæ, which penetrates the cellular body and there terminates in a slight enlargement.

In his researches on spermatogenesis of the Batrachians, Duval has established that, in the red frogs, where the development of the spermatic elements can be followed from their origin to their complete formation, this development must be watched for more than eighteen months to note all the phases.

"If we examine the section of a seminiferous tube in the month of November, for instance, we find, with little magnifying, that this section (Fig. 69) forms an elegant design made by the fascia of spermatozoids (FS and fs), which are regularly placed like the spokes of a wheel. That is, the pencils formed by the caudal filaments (fs) point towards the centre of the canalicule, the lumen of which they almost completely fill, leaving only a small central space free (A), which is surrounded by these pencils, more or less distinctly separated from each other. The shorter and more distinctly marked fascia (FS), formed by the heads of these same spermatozoids, point towards the wall of the canalicule in which they seem implanted in the midst of a granular mass (G) strewn within nuclei easily seen with a higher power.

"At a power of from 320 to 400 diameters, the details of this implantation are seen to be as follows: The corresponding extremity of the fascia, formed by the heads of the spermatozoids, is continued by a band of granular matter which adheres to the wall of the canal. At the sides of this band, and on the walls of the canal, are anatomical elements, some in the shape of nuclei, others as cells. The first we will call granular cells, the second are the male ova. By comparing the different forms of granular cells and male ova, we find a series of forms intermediate between the granular cells and the male ova.

"That is, these last are only a transformation, a more advanced state of the former.

"If we begin our study with these elements, we will have to examine what becomes of, first, the fascia of the spermatozoids, and secondly the granular cells and male ova.

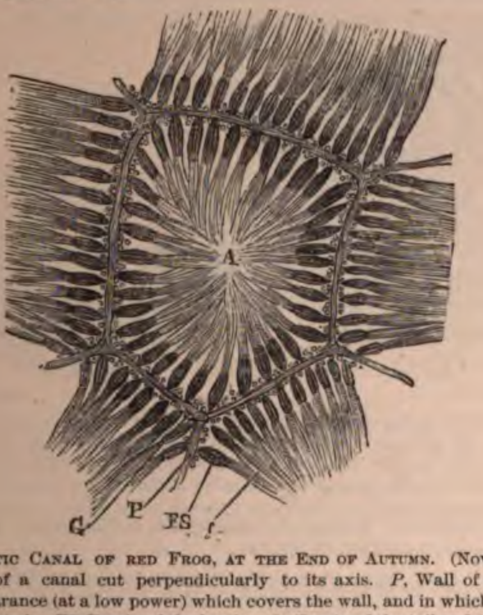


FIG. 69.—SPERMATIC CANAL OF RED FROG, AT THE END OF AUTUMN. (November 15) (*Duval*). —*A*, Central lumen of a canal cut perpendicularly to its axis. *P*, Wall of canal. *G*, Mass of a nucleolus-like appearance (at a low power) which covers the wall, and in which the fascia of spermatozoids are implanted. *FS*, Fascia of the heads. *fs*, Fascia of the tails of these spermatozoids (magnified about 110.)

"The fascia of the spermatozoids separate, towards the end of November, little by little from the wall, lose all connection with it, become free, and in February, and the beginning of March, they enter the excretory canals. (Figs. 70 and 71.)

"As for the granular cells and male ova, we will see, during this same period, the multiplication of the granular cells, their evolution into male ova, then, after this period, the transformation of the male ova into large cells with many nuclei, which are themselves transformed, during a second period, after March, and during the whole of spring and summer, into fascia of spermatozoids.

"In December and January, the male ova become larger, their nuclei show distinctly two nucleoli: the granular cells have multiplied, and some show characteristic signs of segmentation. At this moment, the male ova are immersed in numerous granular cells, which are occasionally multiplied sufficiently to completely surround the ova.

"In February, and the first days of March, the male ova become very large, and, at the same time, their nuclei segment. A section of the seminiferous canals, examined at this period, shows that the fascia of spermatozoids are no longer regularly attached to the wall of the canal, but that they are floating in the cavity of the latter. But what is most remarkable, in a section at this period, is the appearance of an epithelium with large cells (OS) (fig. 71) which covers the walls. By the aid of a higher power we find that this epithelium is formed simply of large male ova, the nuclei of which are more or less advanced in their segmentation.

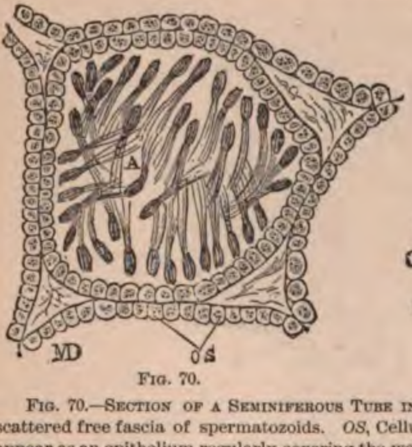


FIG. 70.

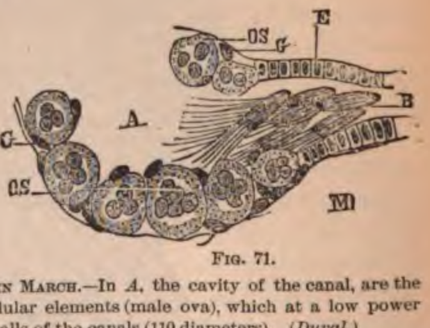


FIG. 71.

FIG. 70.—SECTION OF A SEMINIFEROUS TUBE IN MARCH.—In *A*, the cavity of the canal, are the scattered free fascia of spermatozoids. *OS*, Cellular elements (male ova), which at a low power appear as an epithelium regularly covering the walls of the canals (110 diameters). (*Duval.*)

FIG. 71.—WALL OF A SEMINIFEROUS TUBE AND ITS CONTINUATION WITH THE EXCRETORY CANAL, magnified 300 diameters.—*OS*, Large male ova with segmented nuclei. *G*, Cells or granular nuclei on the surface of the male ova. *B*, Excretory canal with its epithelial cells. *E*, Some free fascia of spermatozoids are entering this duct. (*Duval.*)

"During the whole of the months of March and April, the seminiferous canaliculi present this same appearance (see Figs. 70 and 71). Around each of these male ova are placed granular cells (G), some in contact with the wall of the canal, others on the projecting parts of the male ova, that is, on the parts towards the centre of the canal. But these granular cells are never abundant enough to cover the whole surface of the male ova, to form about each one of them a layer, or, as some writers have said, a complete envelope.

"In May and June, we have only to note the continuation of the segmentation of the nuclei of the male ova, and the augmentation in volume of these ova. To the appearance of a regular epithelium on the walls of the canaliculi, has succeeded that of a series of irregular projecting bodies of different sizes, but in which it is easy to recognize male ova, provided with a great number of nuclei. When these elements have attained this degree of development, it is difficult to keep the name of male ova, and we will, at the end of this period, call them spermatic cysts.

"Among these spermatic cysts are yet found male ova less advanced in their phase of nuclear segmentation, that is, there are all forms of transition between male ova and spermatic cysts.

"In June, the spermatic cysts are so large that they project towards the central portion of the lumen of the canal.

"From the first days of July, the disposition of the nuclei in the spermatic cysts takes a very peculiar aspect. The nuclei all pass towards the periphery, and are there ranged in a single, regular layer. The centre of the cysts is then formed of a homogeneous and finely granular protoplasm.

"During the last of July and August, there occurs a sort of rarefaction of protoplasm in the portion of the cysts that points towards the centre of the seminiferous canaliculi, that is, in the free portion of the cysts. The limits of the cystic cell, clearly defined in the zone of the nuclei, become indefinite at this central extremity, from which the nuclei retire to a small portion. Soon the cyst appears as if open at this point. Now, and occasionally before, the protoplasm of the cystic cell begins to condense into bands placed in a radiating manner, that is to say, springing from the peripheral zone of nuclei and converging toward the centre.

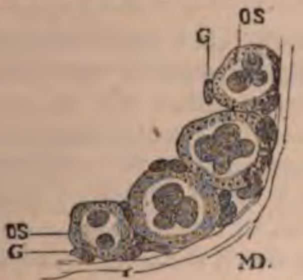


FIG. 72.—EXAMINATION, WITH A VERY HIGH POWER, OF MALE OVA (*OS*) WITH MULTIPLE NUCLEI, AND OF THE GRANULAR CELLS WHICH LINE THE WALLS OF THE CANALICULI of Fig. 69.—300 diameters. (*Duval*).

"When this sort of dehiscence is well marked, we find, during the month of September, a more distinct disposition of the protoplasm in radiating bands, and a modification of the nuclei which are still peripheral. First, the protoplasm forms triangular bands, the internal end of which is slender and ill-defined, the external end of which is thicker, forming an inflated and obscure portion, and which blends with the peripheral protoplasm that surrounds the nuclei. Secondly, these nuclei appear to lengthen, and look like a drum-stick, and, in the ultimate transformation, we will show that these little knobs represent the heads of spermatozoids.

"In September, the spermatic cysts form a pouch, the walls of which have a layer in which the heads of the spermatozoa, which are forming, lie regularly alongside of each other. This pouch, free at its central and upper portion, has its intermediate zone occupied by delicate bands of protoplasm, each of which corresponds to a future spermatozoön.

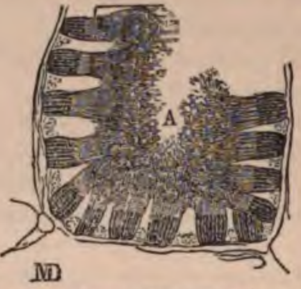


FIG. 73.—SPERMATIC CANALICULE ENCLOSING BUNDLES OF SPERMATOZOIDS.—Seen in September. (*Duval.*)

"To pass from this pouch into a bundle of spermatozoa, the spermatic cysts need only to undergo retraction of their lateral walls towards their base, or, towards the part in contact with the membrane of the seminiferous tube. At the close of September, the layers formed by the regular coaptation of the heads of the spermatozoa, no longer resemble the walls of a pouch, but look like bell-mouthed cups, crescentic on section. By the end of September, this crescent shape has widened, and all the heads are arranged along nearly the same strait line.

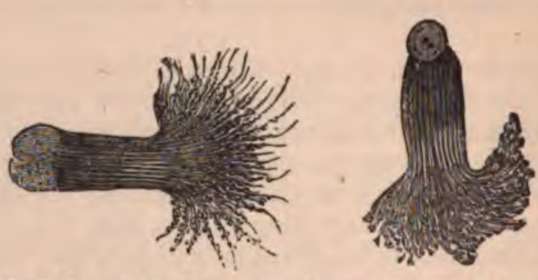
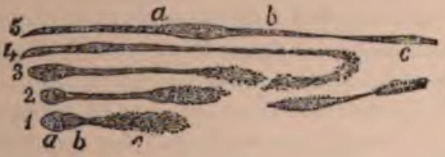


FIG. 74 AND 75.—BUNDLES OF SPERMATOZOA IN OCTOBER (MAGNIFIED 320). PREPARATION BY DISSOCIATION. (*Mathias Duval.*)

"At this period, a section shows the cavity of a seminiferous tubule to be as in Fig. 70. It is seen that the bundles of spermatozoa only have to become thinned and lengthened in order to possess—in October—an identical aspect with that shown in Fig. 69, which was the starting point of our study.

"When the spermatic cysts open at the part looking towards the centre of the seminiferous canaliculi, and when the peripheral layers containing the developing heads begin to retract on the walls of the canaliculi, then the granular nuclei follow this movement, being carried along by their adhesion to the surface of cysts. Thus the nuclei all accumulate towards the base of the bundle that is just forming. Then occurs a remarkable event, and one which completes the cycle we have just reviewed, or, rather, begins another cycle. Those nuclei nearest the wall acquire a cellular body, finally having all the elements of the "male ovule." These give birth to spermatic cysts during the following period, while the granular nuclei, *not* so transformed, will soon multiply, and produce nuclei which will incompletely surround the new spermatic cysts.

"The young male ovules are at the base of the bundles of spermatozoa which are forming near the band of granular protoplasm, binding these bundles to the walls of the canaliculi. In preparations by dissociation, (*i.e.*, bundles torn from the walls of the canaliculi,) we notice that a male ovule adheres to the base of a bundle (Fig. 71 and 72). When this ovule is at the side of the bundle (seen in profile at the base, as in Fig. 71) it is easy to see that it is independent of the bundle, and we can distinguish both the nuclus and the cellular body of the male ovule; but when it projects from the protoplasmic cord forming the base of the bundle (Fig. 72), we can only see the large nucleus of the male ovule, and we are tempted to view it as a nucleus belonging to the base of the bundle, or rather as the analogue of what we have called the principal nucleus for the clusters of spermatoblasts, and bundles of spermatozoa of Hélix and La Paludine. This is an interpretation to which we were strongly urged during our early studies of invertebrata, and when we had not investigated all the phases of evolution in the frog, but which a more attentive examination forced us to abandon."



FIGS. 76.—DIFFERENT ASPECTS OF THE ELEMENTS OF SPERMATOZOA COMPOSING A BUNDLE.—*a*, Cephalic segment. *b*, Intermediate segment. *c*, Caudal filament. (*Mathias Duval.*)

The spermatozoa are the active agents in fecundation, for, if they are absent from the semen, as after certain diseases of the testicles and epididymis, sterility is the result.

Progression of the Semen in the Genital Tract.

In order that fecundation may occur, the spermatozoa must be in contact with the ovule. Spallanzani, Prevost and Dumas, have proven this, and also, that only a minute quantity of semen is necessary. Since the semen is in the vagina and the ovule is in the tube, the two must go in search of each other in order to fuse. Thus fecundation is not instantaneous;—a certain time is demanded for the meeting. In woman, when the follicle ruptures at or near the time of coition, the two elements meet about ten hours later. Ch. Robin states that spermatozoa travel about .78 of an inch in ten minutes. Ejaculation is against the cervix, in woman, but the os is closed, and the canal of the cervix will not allow the injection of the semen into the uterine cavity. Much of the semen flows out, after coition, through retraction of the vaginal walls. Yet enough remains in the vaginal folds and on the cervix to fecundate.

Beigel, and some German authors, describe, in the posterior cul-de-sac of the vagina, the genital or spermatic fossa. The semen is lodged here, and the uterus, after its erection at the moment of coition, being carried forward in a kind of ante-version, the cervix is plunged back into this "spermatic pool," and fecundation is thus favored. In all cases, the spermatozoa, to reach the ovule, pass through the os cervicis. The semen is not carried en masse, but the spermatozoa progress, being resisting elements, while the other ingredients of the semen are destroyed or carried out by the mucus. According to Gerbe and Coste, the spermatozoa begin to enter the os only after 25 or 30 minutes. What is the true cause of this? Is it capillarity, as Coste and Liègeois state? Is the semen sucked up into the uterus, as Riolan, Morgagni, Boerhave and Pouchet state? Is it the peculiar movement of the uterus and Fallopian tubes (Bischoff), or the action of the cilia (Muller)? These opinions are rejected by Henle, Pajot, Joulin and Mathias Duval, who state that the spermatozoa are endowed with motion, and, by an instinct of their own, make their way towards the ovary. Ch. Robin states that they progress individually, as the tubular form of the organ permits, and go on as long as they live and find a proper fluid, thus mechanically passing, not only towards the ovule, but beyond, to the pavilion, the ovary or the peritoneum, whether or not they have met an ovule. This does not pre-suppose a polarity or an instinct in the spermatozoa. "They advance if the parts are moistened with a thin layer of fluid" (Robin). At the pavilion, and ovary, they slip over the peritoneum and are absorbed. The ovule also advances towards the spermatozoa. Where do they meet? Where does fecundation occur?

Place where Fecundation occurs.—The only exact statements are those of Gerbe and Coste. The point of meeting of ovule and spermatozoa is on the ovary, or in the external third of the tube. Extra-uterine, ovarian and abdominal pregnancies, prove this statement. Once below the external third of the tube, the ovule is covered with a layer of albumin, which the spermatozoa can not pierce. Hence penetration must have occurred before this. On the other hand, fecundation does not occur until the germinal vesicle disappears; this disappearance begins when the ovule leaves the ovary and enters the pavilion. It ends in three or four hours.

Segmentation of the vitellus—a sure sign of fecundation—does not occur (at least in birds) until the arrival of the ovum in that part of the tube where the shell forms.

Fecundation does not occur in the uterus, as Pouchet said, but higher up. But, according to Van Beneden and Ch. Robin, the spermatozoa can, in some animals, penetrate the ovules *in anticipation,* and remain living therein, (as in the copulatory pouches of certain invertebrata, etc.,) waiting for the ovule to arrive at maturity, or to undergo molecular changes from nutritive processes.

In woman, the spermatozoa, which have reached the tube before menstruation, remain there during the menses, and fecundate the ovum as soon as the follicle ruptures. The uterine flow immediately ceases (Robin). Fecundation, then, cannot have occurred until 10 or 20 hours after the close of menstruation, supposing coition to have occurred directly the flow has ceased. Hence, coition preceding the flow, produces spermatozoa which fecundate after the flow has ceased.

Bischoff states that the ovule is capable of fecundation for 10 or 12 days, thus explaining how, in some women, impregnation seems to occur midway between the menstrual periods.

Of the phenomena of fecundation, Ch. Robin mentions not only dissolution but liquefaction of the spermatozoa in the ovule; that is to say, molecular modification causing dissolution of its molecules, which finally unite with the substance of the vitellus.

A new being is to grow from this, and, from the transformation, comes original or incarnated heredity that may recur in later impregnation. Hence the well-known idea that the alteration of a species may depend upon the first contact with a debased race; and also, that mares, or bitches, of good stock, once impregnated by the male of a common breed, will, for a long while after, give birth to common stock, even if they have been covered by the highest bred males. Widows, remarrying, have had children who resembled the first husband.

THE CREATION OF SEX AT WILL.

This problem cannot be solved. No one believes with Hippocrates that the right testicle produces boys and the left one girls; or with Millot that the right ovary furnishes male ova, and the left, female. Girou de Buzareingnes stated that the relative vigor of the parents determined sex. Knight attributed to a tonic regimen some influence on the formation of the female sex. Hofacker, Sadler, and Boudin tried to prove by statistics that it depended on the difference in age of the parents:—if the father is younger than the mother there will be more girls than boys, and vice versa.

Thury thought it depended on maturity of the ovule:—cows served at the commencement of rut produced females, those at the end of it, males.

If this is true for cows, it is not so for human beings, for most pregnancies commence after the menses, when the ovum is mature.

CHAPTER III.

STERILITY.

FROM what has just preceded, the causes of sterility may be seen to belong both to man and to woman.

1.—*Causes in Males.*—All that hinders or alters the act of copulation may induce sterility.

α.—Absence of ejaculation.

β.—Obstacles about the urethra rendering ejaculation difficult.

γ.—Absence of spermatozoa in the semen, from epididymitis, syphilis, &c., &c.

δ.—Certain abnormal formations of the external genitals.

2.—*Causes in Females:*—

α.—Abnormal formation of the genital organs.

β.—Obstacles in the uterus or tube preventing progression of spermatozoa or ovule; for example, adhesions, deviations, displacements, and changes in uterine or vaginal secretions.

γ.—Pathological changes in the ovaries.

CHAPTER IV.

ARTIFICIAL IMPREGNATION.

IF impregnation demands activity of both sexes, yet copulation is only for directly ejaculating semen within the female organs, and to facilitate contact between the ovule and the spermatozoa. Copulation is not indispensable, for there are a number of well-authenticated cases where women have been impregnated without insertion of the penis, and where semen upon the vulva has not only penetrated the vulvo-vaginal canal, but impregnated the ovule. Hence the idea of artificial impregnation. Spallanzani successfully tried it upon a bitch in 1780. Hunter, in 1799, for the first time practised it successfully in a woman. He first advised it in a case of hypospadias, and, the husband agreeing, the wife became pregnant. The practice was in oblivion for several years, but, in 1837, Dr. Girault of Paris renewed it, and many have since tried it:—among these are Marion Sims, Gigon d'Angoulême, Courty and Pajot.

In 14 cases, it has been followed by success (Gigon). But two of these 14 do not possess sufficient guarantee. Thus there remain 12 cases which are well authenticated:—

Great length of cervix and small cervical opening	4
Various discharges from uterus and cervix.	2
Engorgement of the lips of the cervix.	2
Falling of the womb	1
Hypospadias.	1
Anteversion and discharges.	1
Unknown causes	1
Cases—	12

Of the 12, 10 gave perfect results, living children being born. In the other 2 cases non-persistence can be adduced as a cause of failure.

To the above Gigon adds: smallness of the penis; excessive or abnormal size of the penis; impossibility of entering in erection, or at least in such a state of erection as allows of copulation; extreme obesity; enormous herniæ; tumors about the groin; retroversion of the uterus; uterine flexions; certain abnormal forms of the os uteri, and of the vaginal canal, and vaginismus. To artificially impregnate, Gigon makes 2 classes:

1st. Indirect.—Semen injected into the vagina, not into the uterus.

2d. Direct.—Semen injected into the uterus itself. The second is the better proceeding by far. Girault, who was the first to do this, used a simple metallic tube as large as a male sound, having at its upper end a little reservoir into which he poured the semen, kept until his arrival in a glass surrounded by tepid water. Before using the tube it should be warmed. The semen flows from this reservoir back to another, which is guarded by a faucet. The tube is introduced into the uterus, the faucet is turned on and the operator gently blows the semen into the uterine cavity. Although primitive, this instrument was very successful in its inventor's hands. Dr. Dehaut invented two instruments in 1865 but never used them:—1, an injector for throwing semen into the uterus; and, 2, a receiver for preserving semen at the proper temperature until injected.

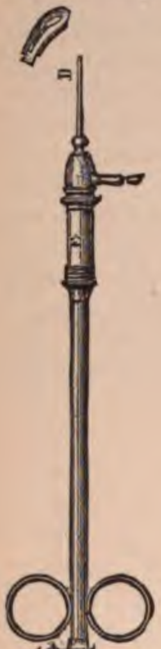


FIG. 77.

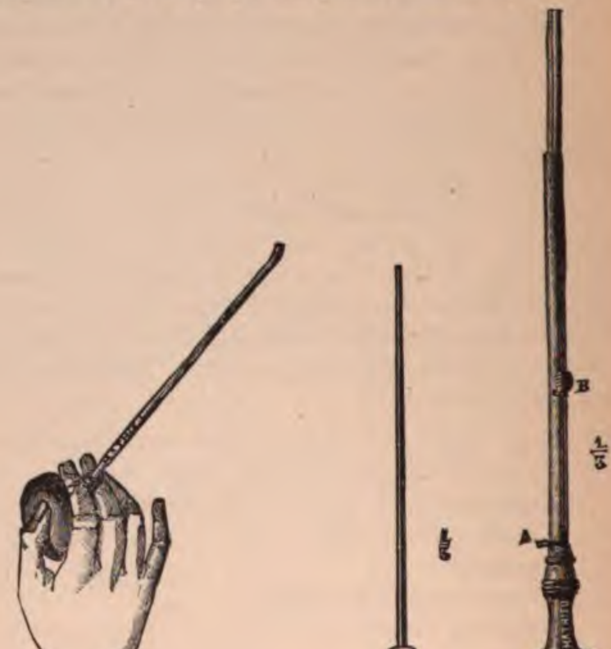


FIG. 78.

FIG. 77.—ROUBAUD'S SYRINGE FOR ARTIFICIAL IMPREGNATION.
FIG. 78.—PAJOT'S APPARATUS FOR ARTIFICIAL IMPREGNATION.

Gigon, slightly modifying Marion Sims' apparatus, advises:—1st.—A thick glass syringe, graduated to millimeters, whose diameter is .39 of an inch. A tube of vulcanized rubber, with screws on one end. The calibre of this is very small, and its capacity is known to the operator. About 1.5 inches from the point of the tube is an enlargement, preventing too deep a thrust into the womb. He proposes to collect the semen in the vagina when this is possible. Courty covers the penis with a condom, in which the semen remains after ejaculation, a little opening allowing the glass syringe (previously warmed to 98.2° to 107° F.) to gather the required amount.

This syringe has a metallic or elastic uterine sound, by means of which the uterine cavity is entered. The piston drives the semen into the womb.

Pajot always collects the semen from the vagina when possible. He used to employ a complex instrument; now he uses this:

A hollow metallic tube, like that used for inducing premature labor, is covered with a rubber tube which projects beyond it by about .78 of an inch.

To one end of this rubber tube is fitted a glass tube about .8 of an inch long, pierced with a little groove, rough at one end. The other end is firmly set in the rubber tube, which ends in a flask-shape, which makes the instrument both a force and a suction pump. The operator draws directly from the vaginal cul-de-sac the semen there ejaculated. The speculum allows us to observe the exact spot of the disposition of the semen: the end of the tube, with the little glass canula, is put into the fluid, and by pressing on the rubber ball the semen is sucked into it; the canula is then introduced into the uterus, and by successive jets the semen is thrown into the uterine cavity. This is very simple, and has been successful, once at least, in Pajot's hands.

It is imperative to examine, first, the husband's semen to see that it contains spermatozoa. The moral side of the question must also be looked into, for this is a delicate operation, only to be done under peculiar circumstances.

If it is to be performed, when is the best time? As near as possible to the close of the menstrual flow, or two or three days thereafter. When done, the woman must lie on her back in bed perfectly quiet for two or three hours. If she menstruate next month, perform it over again. The first attempt is not always successful, and several injections were made by those who have succeeded.

Gigon considers the contra-indications to be, hereditary diseases, cancer, tuberculosis, epilepsy, scrofula, syphilis, lunacy, abnormalities of the pelvis, indeed, anything that may interfere with the vitality of the fœtus or render expulsion impossible.

PART III

PREGNANCY.

INTRODUCTION.

PREGNANCY, or gestation, is the condition a woman is in from the time of fecundation until the expulsion of the fœtus at term. Meanwhile, there occurs, in the economy and organs of the mother, changes that we will separately study. Some of these are peculiar to the mother, others depend on the growth of the ovum, and its change into a fœtus.

Pregnancy is studied in two great classes:

1. Local and general phenomena caused to the mother by gestation.
2. Development of the ovum and formation of the fœtus.

Some have divided pregnancy into healthy, natural, normal or uterine, and extra-uterine.

It is simple when there is one fœtus, multiple when there are two or more children. It may be twin, tri-, quadri-, or quiti-gemellar.

It may also be pathological or complicated. By this is understood the presence of tumors of various kinds in the uterus or its appendages, or in the abdominal cavity.

There is also a false pregnancy; but, as Pajot says, there is, or is not pregnancy, and that those who claim a false pregnancy have been guilty of an error in diagnosis. During pregnancy there occurs a train of diseases and accidents, and also physiological phenomena, which may soon become pathological. Hence complicated and pathological pregnancies will be considered separately.

Our course of study is shown in the following table, taken from Dubois and Pajot.

- Study of Pregnancy with its series of phenomena.
  - *Series I.* Phenomena of Pregnancy.
    - Organic and Functional changes.
      - In the genital system.
        - Pelvis.
        - Internal and External Genitals.
        - Breasts.
      - In other parts.
        - 1° by adjacency.
        - 2° by sympathy.
  - *Series II.* Phenomena of the Ovum.
    - Ovule.
    - Point of departure.
    - Ovum at term.
    - Place of its arrival.
      - Phases of its development.
- Applications to the practice of delivery.
  - DIAGNOSIS.
    - Of Pregnancy.
    - Of the month of pregnancy.
    - Differentiation.
      - Signs obtained by questioning.
      - Sight or inspection
      - Touch.
      - Palpation.
      - Auscultation.
      - Percussion.
  - *Hygiene of the pregnant female.*

CHAPTER I.

PHENOMENA OF PREGNANCY.

ORGANIC AND FUNCTIONAL CHANGES IN THE GENERATIVE SYSTEM.

THE uterus undergoes the greatest changes, but the pelvis also suffers changes, and we will study these first of all.

The Pelvis.

The bony pelvis is unaltered; the articular portions only are those modified in pregnancy. And these chiefly occur in the symphysis pubis.

1st. *Symphysis Pubis.*—If we can not agree with Jacquemier and Mme. Boivin that the symphysis relaxes to the point of disjunction, we must admit that it becomes a lax joint during gestation, as Budin has proved. The two bones can become slightly displaced, which is appreciated by the finger placed under the symphysis when the woman, standing, lifts now one leg, now the other. But these are always limited movements, and are not sufficient, as was formerly believed, to allow increase in the size of the pelvis. When the relaxation is greater, it is accompanied by other phenomena, and is then called relaxation of the symphysis. (See Diseases of Pregnancy.)

There is only an increase in size of the interpubic cartilage from imbibition of a serous fluid, which relaxes the cartilage, and also renders it elastic, and causes it to resemble the intervertebral discs. Its fibres become red and long; it is a phenomena that is analogous to what occurs in certain animals, and which seems to be more marked in women the more children they have had.

2d. *Sacro-iliac Synchondrosis.*—The intra-articular cartilages here undergo the same changes as in the symphysis pubis.

Zaglas and Duncan state that the sacrum revolves about a transverse axis passing through the second sacral vertebra; this thrusts the promontory forward about .9 of an inch, and the coccyx backward. 19 of an inch, when the woman leans far forward. But when she sits or stands, the sacrum projects backward and the coccyx forward, with relaxation of the sacro-sciatic ligaments. After the fourth month Jacquemier has found this, and it increases with pregnancy.

3d. *Sacro-coccygeal Articulation.*—Always movable, this joint becomes more so as pregnancy goes on; at the close of gestation it is so great that, at delivery, the coccyx can move back .39 to 1½ inches. This is always painful, and in some women agonizing.

Excepting this movement, and the truly useful increase in the coccy-pubic diameter, it may be said that the changes in the pelvic articulations are more harmful than useful, insufficient in an abnormal, and useless in a normal pelvis. These relaxations only serve to make the pregnant woman walk unsteadily; and (Pajot) have a very doubtful value.

External Genitals.—The Vagina.

Only in advanced pregnancy (at the third or fourth month) do any appreciable changes occur in the external genitals.

I. *Vulva.*—This becomes moister, more lubricated, swells towards the end of pregnancy, and becomes the seat of more or less œdema, especially in the labia majora which may have varices in them, which are prolonged up to the vagina. The urinary meatus is red, prominent and more or less pigmented. The mucous membrane of the vulva becomes dark red.

II. *Vagina.*—The vagina is altered both anatomically and physiologically. Lengthening about the fourth month from the rising of the uterus, it, however, shortens later on from descent of the womb and engagement of the fœtus. The upper part widens. It becomes violet-red, the papillæ may be prominent, constituting (Deville) granular vaginitis.

The secretions greatly increase, so that erythema of the thighs, and erosion of the labia, with painful pruritus or more or less abundant leucorrhœa result therefrom.

The chief changes are those in its structure. Rouget has proved that the muscular tissue hypertrophies, and, instead of an irregular tissue, the fibres arrange themselves in planes. Thus we see how the vagina gains contractility and extensibility, how it can dilate as the fœtus and its appendages pass through it, and how, later, it returns to the normal. It can also aid the uterus and abdominal muscles in the last efforts to expel the child.

The vascular system also developes, and not rarely we feel a beating artery at the fundus of the vagina, Osiander's vaginal pulse. We have once or twice felt this pulsation in the posterior lip of the os tincæ.

The Uterus.—Of all the organs, the womb suffers the greatest changes, (both in body and cervix) in volume, form, consistency, situation, direction, relations, intimate (histological) structure, physical and physiological properties and functions.

I. *Body of the Uterus.*

1st. *Changes in Volume.*—Even during menstruation the uterus so increases that it rises above the superior border of the pubes on account of catamenial congestion, and can easily be felt on abdominal palpation. Pregnancy increases it still more, but always at the expense of the body and fundus. The cervix is scarcely affected at all. This increase, although rather regular, is not progressive. Although dependent on hypertrophy of the walls and development of the ovum, yet the amount of liquor amnii or the size of the fœtus or fœtuses also produce some variety in it. In some women the increase is by successive jumps, as it were, after a certain amount of development the uterus remains stationary for some weeks, then enlarges again markedly.

There are two causes for the enlargement: (1) distension of the walls from growth of the ovum, and (2) true hypertrophy of the uterine walls, proven by a microscopic examination. There is increase in volume and number of the muscular fibres. This increase is not fixed, depending not only on already named causes, but on the individual. Pajot says: "If some observers find the uterus at full term measuring 15.7 inches along its greatest diameter, others find it only 12 to 14 inches long, including fundus, body and cervix." He gives the following average measurements:

Vertical diameter	14.6 inches.
Transverse "	10.2 "
Antero-posterior diameter	9.5 "
Circumference at the level of the Fallopian tubes	27 to 28 "

The increase is at the expense of the fundus preëminently; and the tubes which, normally enter where the superior and lateral borders join, appear, at full term, to enter at the junction of the upper third with the lower two-thirds. It is not astonishing, therefore, when the virgin uterus, which has a surface of 16 square inches (Levret), acquires, at full term, an extent of surface equal to 339 square inches.

Even if uterine growth does not absolutely occur progressively but by stages, we can arrive at a certain average of growth, if not at each month at least for periods of three months each.

Cazeaux's table is given below.

Measure of Uterus.	Vertical diameter.	Transverse diameter.	Antero-posterior diameter.
Before pregnancy	2.3 inches.	1.7 inches.	.97 inches.
3d month of pregnancy	2.7 "	2.7 "	2.7 "
4th " " "	3.7 "	3.7 "	3.7 "
6th " " "	8.5 "	6.2 "	6.2 "
9th " " "	13.6 "	9.36 "	8.9 "

This increase in volume is accompanied by increase in capacity and weight. The capacity of the virgin uterus is .78 to 1.17 cubic inches. (Simpson). The same author also says that it is about 31.20 cubic inches at full term. Tarnier and Chantreuil regard this as too great, putting the figures at about 19.50 cubic inches.

The weight increases: in nulliparæ it is 630 grains; in multiparæ it is

825. The pregnant uterus weighs 12650 grains (Nœgelé); or 22500 grains (Tarnier); Moreau found one weighing 25500 grains.

2d. *Form.*—The uterus assumes different forms according to the period of pregnancy, because all parts of the uterus do not develop at the same time. The fundus increases considerably at first, while the lower segment is stationary. From triangular, the uterus becomes pyriform; then, when the anterior and posterior surfaces develop, it is spheroidal, and in the last three months, when the lower segment takes part in the growth, the uterus becomes egg-shaped, the larger end up.

Tarnier and Chantreuil say that this ovoid is flattened front and back. Pajot does not believe this occurs, at least not until after death.

Herrgott stated:

1st. The insertion of the tubes corresponded with the junction of the anterior third with the posterior two thirds, showing that the posterior wall developed much more than the anterior.

2°. That side of the fundus in which was one of the fœtal extremities was often higher than the other, especially the right side from the right lateral obliquity of the uterus.

3°. The form of the uterus varied with the presentation, the position and the number of children. These he called physiological causes. Herrgott carefully described many pathological causes—for instance, abnormalities of the pelvis, curvature of the spine, unequal resistance of the uterus and the venter propendulus. (Pendulous abdomen.)

Unequal resistance produced two forms of uterus: one the trumpet shape of Wigand-Herrgott, and the other saccular dilatation.

In the last named, one of the uterine walls underwent far greater development than the other. Herrgott, Wigand and Stolz stated this to be at the expense of the anterior wall; while Depaul stated just the reverse. Depaul also says that one side developes more than the other, so that one tube is from .39 to .78 of an inch higher than the other at its insertion.

3d. *Thickness.*—With all these changes, it is remarkable how slightly altered is the thickness. Mauriceau claimed a thinning of the walls, while Deventer regarded this as rare. Ripault, Tarnier and Chantreuil admit a general thinning, at least toward the close of pregnancy. Velpeau and Depaul think that the womb preserves its normal thickness all through pregnancy; this is our own opinion from autopsies we have made at the Clinic. But there is no definite rule; in one the walls are thick, while in a woman with rickets they are thin. Hunter and Saviard have found partial thinning.

4th. *Consistency.*—The uterus alters in consistency as it increases in size; in place of being hard, firm and fibrous, its walls become so soft and elastic that we can easily feel parts of the fœtus through them. Pajot says it is not soft and flaccid, but rather supple; and one can always distinguish the uterine from the abdominal walls. These characteristics, by allowing the fœtus free movement, prevent abnormal positions and presentations.

5th. *Situation and Direction.*—The change in situation varies in different women, and at different periods of pregnancy. During the first months of gestation the uterus, from pressure of the intestines, and from increase in its own weight, sinks down into the pelvis. In some women, however, the fundus rises above the pubes within the first few weeks of pregnancy. At the third month, it is too large for the pelvis, rising above the superior strait, finally filling all the abdominal cavity, reaching the diaphragm, and diminishing the vertical diameter of the thorax. At the same time the sacro-vertebral angle, and the curvature of the spine, throw the uterus from the axis of the superior strait, and bend it to one side or the other. The uterus usually bends to the right; the reason for this is yet unknown.

Levret thought it was caused by the insertion of the placenta; Desormeaux, by the sigmoid flexure; others thought it to be caused by the greater use of the right arm and by right lateral decubitus; Madame Boivin by the shortness of the right round ligament.

Dubois states that the cæcum on the right would compensate for the sigmoid flexure. Velpeau proved Desormeaux to have made an anatomical error by giving to the mesentery a direction from above downward, and from right to left. In left-handed women the uterus inclines to the right in spite of the arm that is chiefly used. Pajot measured the round ligaments and did not find the left one longer than the right, except in a few cases.

Rotation.—While undergoing inclination the uterus also, (during the last months of pregnancy), rotates on its axis, the anterior surface turning to the right, thus bringing the left lateral wall anteriorly.

This rotation, rudimentary in women, is well-marked in some animals, the womb revolving completely on its axis, twisting the vagina on itself, and thus arises an impassable barrier to delivery.

6th. *Relations of the Uterus at Term.*—The upper three-fourths of the anterior surface of the uterus rests against the internal abdominal wall, from which it is separated by the omentum or intestinal folds. Below, it touches the posterior surface of the bladder; the extent of this relation depends on the amount of fluid in the bladder. Posteriorly, it is in relation with the rectum, sacrum and its promontory, the iliac vessels and the first branches of the sacral nerves. Above the promontory, the uterus touches the mesentery, the intestine (which often separates it from the aorta), the inferior cava, the ureters, the columns and the posterior surface of the diaphragm.

The fundus is in relation with the anterior abdominal wall, transverse colon, anterior border of the liver, greater curvature of the stomach and the diaphragm, from which it is separated by the organs named.

The right lateral border is in relation with the external and internal iliac vessels, obturator vessels and nerves, the psoas and iliacus muscles, cæcum, ascending colon and the abdominal wall. The left border is in relation with the iliac vessels, the obturator vessels and nerves, the psoas and iliacus, the sigmoid flexure, the descending colon, and folds of intestine pushed over by the right obliquity of the uterus.

Below, the inferior segment of the uterus and the cervix project into the vagina. The bladder is in front, the rectum behind.

Hence, Pajot states, the uterus rests on the anterior wall of the abdomen, which forms for it an elastic and supple plane, preventing shocks to the fœtus from walking, movement, etc. This also explains the part played by the abdominal wall in the last moments of delivery.

The Cervix.

The cervical are as important as the corporeal changes, though different in their nature. Pajot states: "there are general, daily changes in the cervix during pregnancy; but there are many exceptions to this rule, and numerous degrees in the amount of change." These we will study. As in the body, the changes may be in consistency, extent, form, size of orifice and cavity, direction and position.

1st. *Consistency.*—The first change is softening; this is gradual, and does not occur equally in all parts of the cervix. It increases until the whole cervix is softened at full term. It begins in the mucosa of the os tincæ, and the internal portion of the lips, then it occurs throughout the whole lip and the remainder of the cervix, the upper portion being softened last of all. Thus the process is from below up; and this, too, in primiparæ as well as multiparæ. But as the cervix of the latter is shorter, from previous pregnancies, the softening appears to be more rapid. In primiparæ the softening is more marked, and in the third to fourth month the os tincæ is softened to a depth of .11 to .19 of an inch; at the sixth month, it has extended half through the vaginal portion; at the eighth month, all the vaginal portion is soft; and during the ninth, the supravaginal portion commences to soften.

The causes are (Lott), first, increase in size, and augmentation of number of the cervical elements; and, secondly, stasis from pressure of the fœtal head. The latter cause is potent chiefly towards the close of gestation.

2d. *Size.*—It is a mooted question whether the length, width and thickness of the cervix undergo change during pregnancy.

While many of the older authors (Rœderer, Stein, Baudelocque and later, Velpeau) claimed that there was progressive shortening of the cervix during pregnancy, Stolz, Pajot, Depaul, Scanzoni and Cazeaux denied that any change in length occurred, and that the shortening was simulated by the approach of the internal and external orifices, and widening of the space between them. Mme. Boivin, Kilian, Holst, M. Duncan, Tarnier and Chantreuil claim that it is elongated rather than shortened, although they limit this increase to a few hundredths of an inch. Taylor, Spiegelberg, Muller, Schrœder and ourselves agree with Stolz, Pajot, Dubois and Depaul. In 1877, Martin studied this subject, and, after many measurements in multiparæ and primiparæ at different epochs of pregnancy, he drew the following conclusions:

In the later months of pregnancy, the cervix increases in all directions in both primiparæ and multiparæ. It grows longer and wider. The engaging of the head has no other influence than to hasten this change, and to cause its rapid and perfect completion. The differences in size in the cervix in the last months of pregnancy cannot be appreciated, either in primiparæ or multiparæ, with exactitude, and hence cannot aid in differential diagnosis.

Martin admits that the cervix lengthens, and Tarnier and Chantreuil agree in this opinion. But this, for them, is only slight, while Martin's figures are a little larger. The precautions the latter took in measuring seem to prove a true lengthening, and one can no longer say, with Stolz, that the cervix lengthens only two weeks before delivery.

During these two weeks, Stolz, and Tarnier and Chantreuil, state that the cervix suffers another change, its obliteration. We have found this phenomenon occurring later on, often in the three or four days immediately preceding delivery.

This obliteration is totally different from dilatation of the cervix. The latter is a physiological phenomenon of labor, while the former is a phenomenon of pregnancy, which regularly occurs during the last days, I might say in the last hours of pregnancy, by an insensible labor, of which the woman is not aware. It precedes dilatation, and warns us of the onset of delivery. It is always understood that we speak of delivery as at full term.

Obliteration of the cervix does not always cause opening of the cervix; and, in primiparæ, it may be obliterated, while the external os is closed until labor pains come on.

All agree that the cervix is obliterated from above downwards;—and Tarnier and Chantreuil were wrong in ascribing to me the opinion that in multiparæ the reverse was the case. They allude to a statement of Stolz:—“ In the first pregnancy the cervix disappears from within out; in subsequent pregnancies from without in.” Our opinion is that it always begins at the internal os. But as in multiparæ the external os is often large, it *might* seem that obliteration began here: hence the error.

Tarnier and Chantreuil state that when, during labor, the cervix has to be cut, it is the external, and not the internal os that is incised; and

Pajot states that when, after delivery, the cervix returns to normal, it is at the internal os that the changes first begin.

Stolz thus describes obliteration:—"The two ora of the cervix go to meet each other, the middle of the cervix increasing in width thereby. The internal os opens, and the cervix merges with the inferior segment of the uterus, and all that remains of the cervix is the external os.

"In multiparæ the external os is deep, round, basin-shaped, somewhat open, and allows the introduction of the finger. And thus, in multiparæ, the cervix disappears from without in."

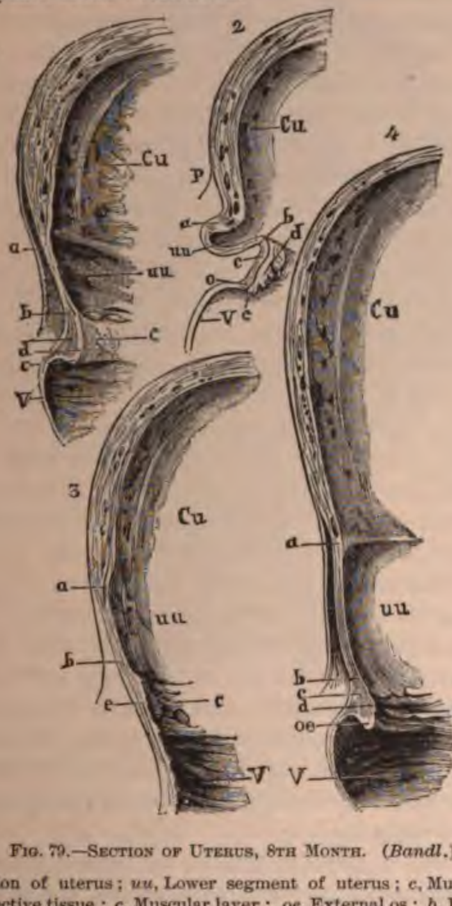


FIG. 79.—SECTION OF UTERUS, 8TH MONTH. (*Bandl.*)

FIG. 1.—*Cu*, Section of uterus; *uu*, Lower segment of uterus; *c*, Mucous membrane of cervix; *d*, layer of connective tissue; *c*, Muscular layer; *oe*, External os; *b*, Point at internal os corresponding to Müller's ring; *a*, Internal os of Braune; *v*, Vagina.

FIG. 2.—Section of a uterus at the seventh month in a primipara.

FIG. 3.—Section of the uterus of a woman who died in the middle of the ninth month of her first pregnancy.

FIG. 4.—Section of the uterus of a primipara dying in the tenth month of her pregnancy.

We do not share this opinion; but regard obliteration as always occurring from above down.

Once this operation completed, the uterus consists of a single cavity closed by the os externum, which is often difficult to determine in primiparæ. But in multiparæ a groove can be felt.

Tarnier states that "the lower segment of the uterus is represented by the cervix, the thin walls of which are stretched in the form of a sebilla whose diameter is about 4 inches. Painless contractions of the uterus are the causes of this obliteration, which progresses from above down, while softening is from below up."

Braune, Müller, Birnbaum, Lott and Bandl have lately studied cervical changes during pregnancy. Braune made autopsies in cases of death during the later months of pregnancy, and found the cervix 4.2 inches long anteriorly and 3.9 inches posteriorly. This increase was at the expense of the lower uterine segment. (See Fig. 79). Müller admits the conservation of the cervix until the end of pregnancy, even until the beginning of labor. In most cases he says, when the head is engaged, and the cervix admits the finger, which can touch the membranes, we find, in primiparæ, that the finger does not immediately reach the membranes and the head, but is separated by a space of ¾ to 1¼ inches.

At the apex of this space is the os internum, through which the membranes may be felt. Here there is a muscular ring like a sphincter, and when the finger passes this it finds the walls of the uterus flaccid.

This wall, which is in immediate contact with the head, Müller says is formed by a kind of invagination of the uterine wall and by the anterior wall of the cervix. Hence the projecting muscular ring above described.

According to Müller, the descending head pushes before it into the pelvis the anterior wall of the uterus, and is thus in a pouch in front and underneath the os internum, which is formed by the lower segment of the uterus. The cervical canal is thus about .78 to 1.17 inches long. Bandl observes that this canal, having a length of .78 to .9 inches, and which he has always found to have thin walls when the head was low down, does not correspond to the size of the virgin cervix, which measures 1.36 inches. (Henle and Luschka). And since no one has proven obliteration of the cervix during pregnancy, but, rather, an increase from enlargement of, and additions to, its primal elements (Müller—Lott), as well as softening of its mass, the above cannot be explained except by changes occurring during pregnancy.

Lott recognizes the isthmus of Müller, but says it is formed by the anterior portion of the lower segment of the uterus, the anterior wall of the cervical canal, by the region of the internal os, and even by the lower portion of the posterior wall of the uterus.

There is not a true invagination of all the anterior wall of the lower segment of the uterus and of the cervical canal, but only of their mucosa, and a portion of their stroma. Bandl accepts Lott's statements: Müller's ring is only accidental, that is, a fold of the vaginal wall of the cervix between the cervix and the head. The internal os of Müller is only fictitious, and the tissue of the cervix is absorbed by the lower segment of the uterus. Bandl, agreeing with Braune and Martin, describes the event as follows (see Fig. 80):—The cervix lengthens during the first six months of pregnancy: but in the last ten weeks it shortens, the lower segment of the uterus widening and thinning, and it helps to form a canal—the cervico-uterine,—destined to replace the cervical canal; this, Braune's canal, is for lodging the fœtal part after its engagement. The canal has three orifices. The lower, (the external ring,) is the os externum, about which all authors agree. The middle,—the internal os of former authors,—or the isthmus of Müller, is made by a kind of invagination of the vaginal wall of the cervix, the last trace of the os internum, which disappears at the end of pregnancy when it is absorbed by the lower segment of the uterus. At this point the cervical mucosa disappears, gliding over the muscular layer, forming folds so that the os internum approaches the os externum. Below the remains of this os internum the widened portion of the lower segment of the uterus forms a thin-walled cavity, the true canal of Braune, limited below by Müller's isthmus, or os internum, and above, at its junc-

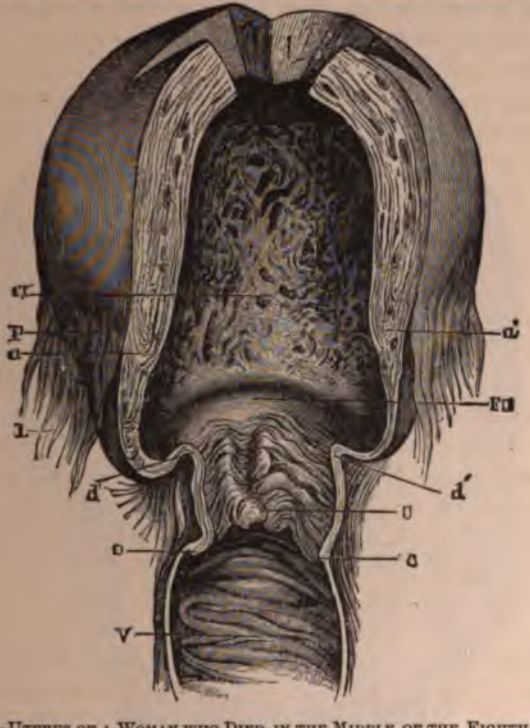


FIG. 80.—UTERUS OF A WOMAN WHO DIED IN THE MIDDLE OF THE EIGHTH MONTH.

cu, Section of uterus; *p*, Peritoneum; *a*, *a'*, Braune's orifice; *fu*, Lower segment of the uterus; *l*, Broad ligaments; *d*, *d'*, Orifice of Müller; *c*, Uterine mucosa; *oe*, External os; *v*, Vagina.

tion with the body of the uterus, nearly on a level with the peritoneal vesico-uterine cul-de-sac, by a thickening of the wall and a ring-like projection of that wall, Bandl's ring.

[The existence of Bandl's so-called ring is by no means universally accepted. Quite recently Lusk read a paper before the Am. Gyn. Society (vol. 9 of Transactions), and stated that in two cases of autopsies of women dying in the last months of pregnancy he had been unable, as well as Welch, to find any trace of this ring. He gives it as his opinion that it would be well to abandon the term "ring of Bandl" and "ring of Müller," because neither of them are at all constant.—Ed.]

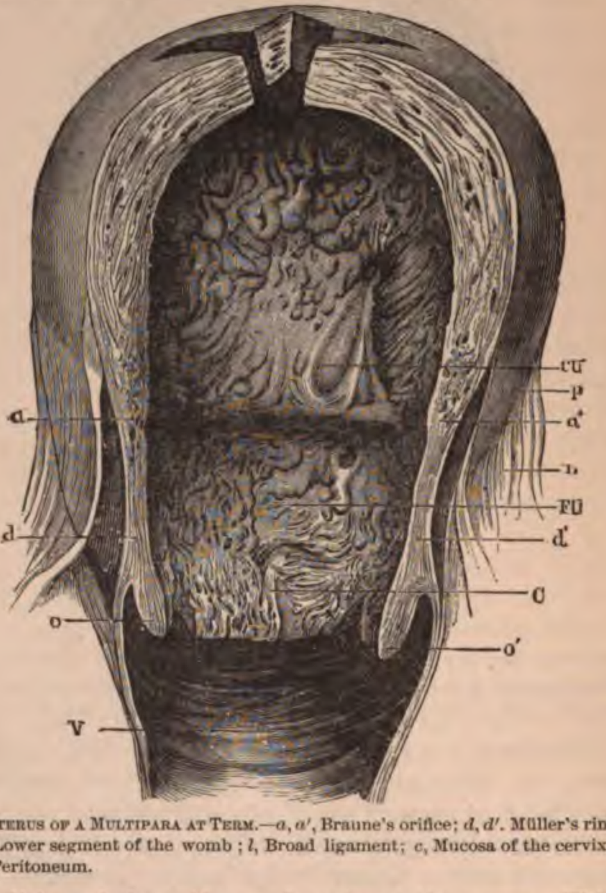


FIG. 81.—UTERUS OF A MULTIPARA AT TERM.—*a*, *a′*, Braune's orifice; *d*, *d′*. Müller's ring; *o*, *o′*. External os; *fu*, Lower segment of the womb; *l*, Broad ligament; *c*, Mucosa of the cervix; *cu*, Body of uterus; *p*, Peritoneum.

3d.—Condition of the orifices and cavity of the cervix.—This is very different in the primipara and the multipara.

A. *Primipara*—The external os ceases to be a transverse slit and becomes round,—a cupola with smooth and regular borders. The great point is that it remains closed until labor. Only when touch has been repeatedly practised, or when uterine contractions have occurred in the later months of gestation—attempts at abortion—do we find the os externum slightly patent. It can, however, be forcibly passed, and then the widened cervical cavity is reached. The os internum is firmly shut and remains so until obliteration of the cervix. The cervix is long, conical and the apex points downwards. (See Figs. 34—39 inclusive.)

B. *Multipara.*—The external os becomes round, bell-shaped, and the borders are irregular, with hard, projecting nodules separated by notches, which are the remains of lacerations in previous pregnancies.

The internal os is easily reached. This orifice remains closed until term; but sometimes it is open,—during the last weeks,—and the finger may reach the membranes. It is never as wide as the external os; and the finger feels itself in a canal which narrows from the external to the internal os:—a cone with the apex upwards. The diagnosis of the epoch of pregnancy can only then be made in multiparæ from the permeability of the cervix.

Once obliterated, all that remains of the cervix is a depression—the os tincæ—closed in primiparæ, open in multiparæ.

4th.—Direction.—Normally, the cervix points backwards and downwards, to the sacro-coccygeal articulation, is in the middle line, and occupies the axis of the superior strait.

During pregnancy, when the body leans toward the right, the cervix points to the left;—of course, when the uterus leans toward the left, the cervix points to the right, but this is rare, as we have stated.

Again, the uterus, leaning forward, throws the cervix backwards; and this is best marked in primaparæ from engagement of the head which, pushing before it the lower segment of the uterus, causes the cervix to rise upwards and backwards. At the end of pregnancy the cervix is situated high up behind and to the left.

In multiparæ it is the same, except that it does not rise as high up. At the commencement of pregnancy the heavy uterus causes a lowering of the cervix.

III. *Structural Changes in the Body and Cervix of the Uterus.*—Each layer demands separate study:—serous, muscular and mucous.

1st. *Serous changes.*—During gestation, the peritoneum plays a large part in the changes of the economy. To-day we do not believe that it, and the broad ligaments, merely unfold;—but all authors, from the researches of Jacquemier and Rouget, admit that there is hypertrophy and hyperplasia of the peritoneum, as well as distension and unfolding of that membrane.

Traces of this distension are found in the inequalities and cicatrices met with around the tubes, the sub-pubic ligaments and the ligaments of the ovary.

The chief point is, that the peritoneum not only does not thin out, but thickens at some points, elsewhere preserving its normal condition.

It is impossible for the peritoneum to distend enough to accommodate the uterus unless it undergo hypertrophy.

The sub-peritoneal cellular tissue becomes less dense and more areolar, and, Depaul states, this affords facility of movement to the peritoneum which may be an obstacle in Cesarian section.

2d. *Changes in the muscular Layer.*—These are remarkable. When empty, the uterus is composed of a dense, firm, compact tissue, like bacon, which cannot be separated into layers. During pregnancy this is completely changed.

The muscular fibres, so small in an empty uterus, increase in every direction, but especially in length, and new elements arise, as is proved by Robin, Kölliker and Schatz. The connective-tissue develops along with it, so that, finally, there results a purely muscular organ, strong enough to expel the fœtus. At the same time the fibres tend to become striated, like the voluntary muscles. In this organ modern anatomy has discovered several layers.

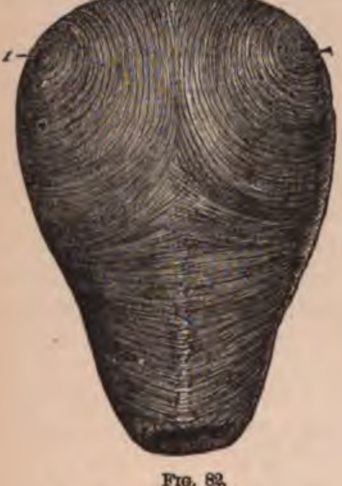


FIG. 82.

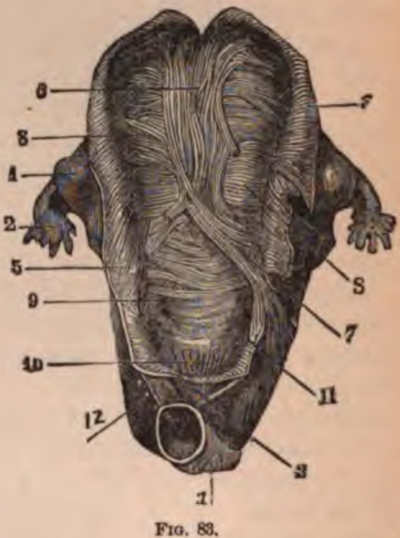


FIG. 83.

FIG. 82.—INTERNAL MUSCULAR LAYER.

FIG. 83.—MUSCULAR FIBRES ON THE POSTERIOR SURFACE OF THE WOMB.—1, Ovary ; 2, Tube ; 3, Vagina ; 4, Rectum : 5, Superficial transverse fibres cut and turned back ; 6, Deep fibres, or ansiform fascia ; 7, Their continuation with the transverse fibres ; 8, Transverse fibres ; 9, Transverse fibres of cervix ; 10, Posterior part of the vagina ; 11, Fibres helping to form the vagino-rectal fascia ; 12, Vagino-rectal fascia (*Hélie* of Nantes.)

Vesalius, Nortwich, Sue, Hunter, Meckel, Calza, Mme. Boivin, Deville, Pappenheim, Rouget and Sappey, studied the structure of the uterus, and

Chenantais and Hélie (of Nantes) have given a classical description of it, from which we take what follows.

There are two sets of fibres in the uterus: the intrinsic and the extrinsic.

A. *Extrinsic fibres.*—Rouget proves that in animals the uterus is covered with a muscular envelope covering the anterior and posterior surface of the organ, doubling over the broad ligaments throughout their entire extent, and attached to the pelvic walls, after having given off fibres to the round ligaments, the ligaments of the ovary, to the ovary and to the Fallopian tubes. These he calls extrinsic fibres. (See Fig. 41). In woman there is but a single group of fibres, which do not form a true layer, but only a kind of mesh-work composed of large links, whose fibres spring from the round ligament, ligament of the ovary and tube, cross over the front of the organ, and go to strengthen the broad ligaments of the opposite side. These fibres are best marked posteriorly, and form the "posterior round ligament." A few of these fibres are found in the utero-vesical folds and utero-sacral ligaments. Other fibres are lost in the ovary and Fallopian tube.

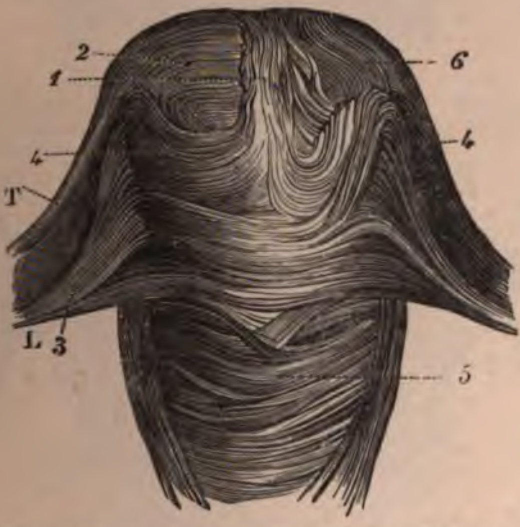


FIG. 84.—ANTERIOR SURFACE OF UTERUS.—(Superficial layer.) *T*, Tube; 1, Median layer; 2, Transverse fibres: 3, Fibres of round ligament spreading over the anterior surface of the womb; 4, Fibres from posterior part of the round ligament, which curve over in folds before reaching the median layer; 5. Fibres of the cervix uteri; 6, Oblique fibres.

B. *Intrinsic fibres.*—Hélie divides these into three layers.

A. *External layer.*—This consists of two layers, one of which Hélie calls the ansiform or arciform fascia, already described by Sue, Calza, Boivin, Deville, Dubois and Pajot. It consists of longitudinal fibres, which pass from the posterior surface of the uterus over the fundus to cover also the anterior surface. Behind, it begins on a level with the union of the cervix and body of the uterus, and is made up of fibres that, at first, were transverse but later are longitudinal. It increases as it rises from the addition of new elements. At the fundus, the lateral fibres run out toward the tubes and broad ligaments, mingling with the extrinsic fibres. The central fibres alone, then, cover the fundus. This layer was described by Deville, who claimed that these fibres formed a Z, running from left to right; Hélie denies such interlacing, or at least claims that only *a few* fibres so cross over.

The second layer of the superficial fibres is transverse, some forming the ansiform layer, while the greater number pass below to run out on to the broad ligaments, the ligaments of the ovary, the round ligament and the Fallopian tube. At the angles of the uterus they curve in an arched form.

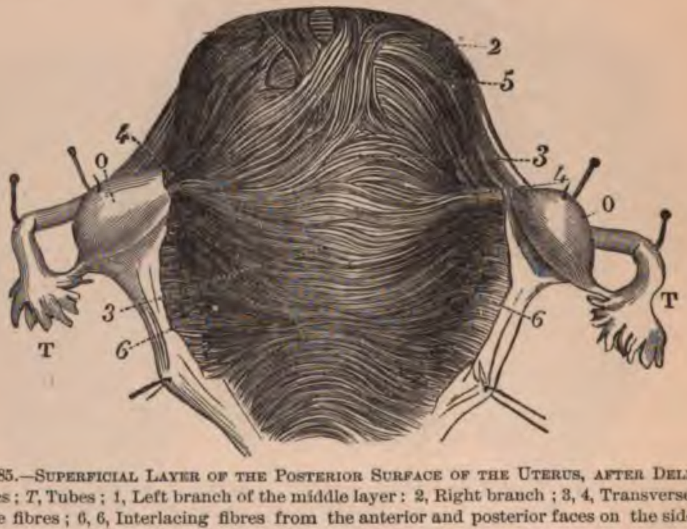


Fig. 85.—Superficial Layer of the Posterior Surface of the Uterus, after Delivery.—*O*, Ovaries; *T*, Tubes; 1, Left branch of the middle layer: 2, Right branch; 3, 4, Transverse fibres; 5, Oblique fibres; 6, 6, Interlacing fibres from the anterior and posterior faces on the side of the womb.

The borders of the uterus are made up of transverse fibres, running from one face to the other, now horizontal, now arciform, and now circular. The deep become superficial and *vicè versa*. They are dissociated by vessels that run in them, and then penetrate the sides of the uterus. Part of these fibres go to the broad ligament, ovary and tube, but the greater number pass to the sides of the uterus.

In the Cervix.—Hypertrophy of the muscle-fibres is, here, less than in the body. There is no ansiform layer, the fibres running from the sides of the uterus to the median line, and interlace among themselves. At the sides of the organ, they run from one face to another. The most superficial fibres run to the utero-vesical folds in front, the utero-sacral behind, and the vagina below.

b. *Middle Layer.* (Fig. 86).—This is indeterminate. It is made up of muscle-fibres running in every direction and interlacing; they form rings about the veins—indeed, sheaths for each one of the uterine veins. The arteries are likewise covered by these fibres, but are also provided with a cellular sheath wanting in the veins, so that the latter adhere by their internal tunic to the muscular tissue, whereas the arteries glide within these sheaths.

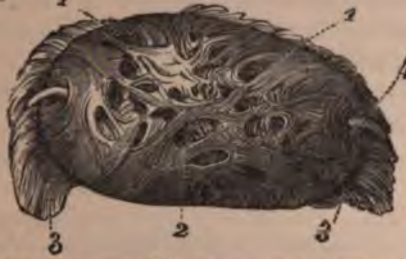


FIG. 86.—MIDDLE LAYER OF UTERINE TISSUE FROM THE FUNDUS, WHERE THE PLACENTA WAS INSERTED.—The interlacing fibres form rings around the vessels which are thereby constricted.—1, Sinus ; 2, Fascia of the internal layer ; 3, 4, Superficial layer dissected.

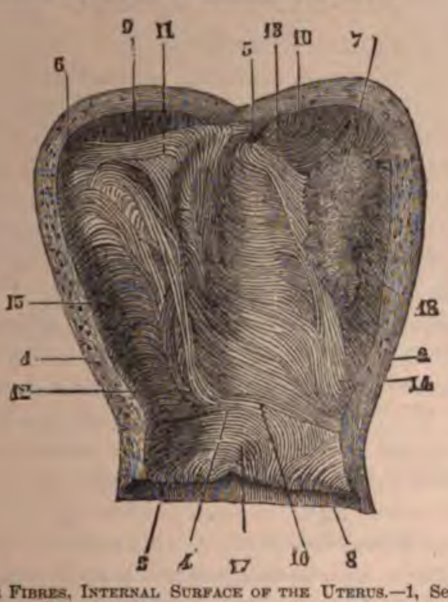


FIG. 87.—MUSCULAR FIBRES, INTERNAL SURFACE OF THE UTERUS.—1, Section of uterus along right border, posterior wall ; 2, Anterior wall ; 3, External os of cervix ; 4, Internal os ; 5, Uterine orifice of left tube : 6, Orifice of right tube ; 7, Insertion of placenta upon anterior wall ; 8, Vagina ; 9, Vertical fibres ; 10, Same, curving over fundus upon anterior surface ; 11, Transverse fascia running from one tube to the other ; 12, Origin of triangular fascia of posterior wall ; 13, Portion of same of anterior wall ; 14, Its origin ; 15, Transverse fibres ; 16, Transverse fibres at the os internum ; 17, Fibres of cervix ; 18, Venous sinus. (*Hélie* of Nantes.)

c. *Internal Layer.* (Fig. 87).—Posteriorly, this is formed by a triangular layer extending from one tube to the other, and down to the cervix. Like the ansiform layer of Hélie, it consists of transverse fibres, which interlace with those of the opposite side. The upper end of this layer terminates in the orifices of the tubes.

On the anterior surface, the triangular layer is less marked. At the side of these triangular masses, transverse fibres pass from one surface of the uterus to the other, forming arches, which become circles around the orifices of the tubes: the orbicular muscles.

In the Cervix.—The internal os is defined by a muscular ring separating the cavity of the cervix and the body. The internal layer is made up of vertical fibres, which form the arbor vitæ, and of interlacing fibres forming incomplete rings, that are well marked about the external orifice.

The uterus is thus formed of three layers, the external and internal layers of which, longitudinal and transverse fibres, are disposed to expel the fœtus, opposing the annular fibres of the cervix. The middle layer acts on the circulation. Pinard says each ring seems to be a living ligature about the uterine vessels, limiting the blood supply and preventing hemorrhage.

IV. *Changes in the Mucous Membrane.—Decidua.*

The uterine mucosa suffers great changes. It is to cover the ovum and with it to sever its connection with the internal surface of the uterus: hence the name decidua. Coste and Robin were those who finally overthrew the ancient theory [Hunter's] and established the true one.

The existence of a mucous membrane of the uterus was not known to older writers, who, however, described a third envelope of the fœtal coverings. Hunter, Moreau, Breschet and Velpeau thought that, under the influence of fecundation, a layer of coagulable lymph covered the internal surface of the uterus.

The ovum, coming from the tube, met this membrane, pushed it in front of it, producing two folds: one the parietal or true decidua, adherent to the uterus; the other the ovular or reflected decidua, in contact with the ovum. But as they saw that the ovum was separated from the muscular layer of the uterus by a membrane identical with these two, they said the ovum induced an irritation which led to the secretion of lymph, where the ovum began to push out the parietal decidua to transform it into the reflected decidua. As this membrane was between the ovum and the uterus, and as it appeared late, it was called the intermediate decidua, or decidua serotina (serotina tardiva). (Fig. 88.)

As it developes, this serotina joins the fold formed by reflection of the parietal decidua and becomes one with it. Thus the three deciduæ are one. But as the ovum grows, it pushes ahead of it the decidua reflexa, which also tends to unite with the parietal decidua. But the two deciduæ formed of lymph are always separated by a layer of fluid lymph:

the hydroperion. Thus, from without inwards, we find parietal decidua, hydroperion, decidua reflexa, chorion and amnion.

This theory was exploded by Coste, who proved that the orifices of the tubes are open as the ovum arrives at the uterus, that the hydroperion does not exist, and that what was formerly believed to be coagulable lymph, was only the changed uterine mucosa, modified in all its elements.

Coste's explanation is as follows: As the fecundated ovum reaches the uterus, the mucosa is swollen and thrown into folds, so that, when the ovum falls into the uterus, near the tubes as a rule, it is caught in one of these folds. In this depression the ovum induces phenomena like that caused by issue-peas. The mucosa bulges up around it and covers it. The point where it still communicates with the uterine cavity is the decidual umbilicus. This soon disappears, and then the ovum is wholly invested. The membrane covering the uterine wall is the parietal decidua; that about the ovum is the ovular or decidua reflexa; the third, where the ovum was primarily implanted, where the villosities of the chorion, and, later, the placenta are to form, is the inter-utero-placental decidua, or decidua serotina. Each of these deciduæ undergoes important changes.

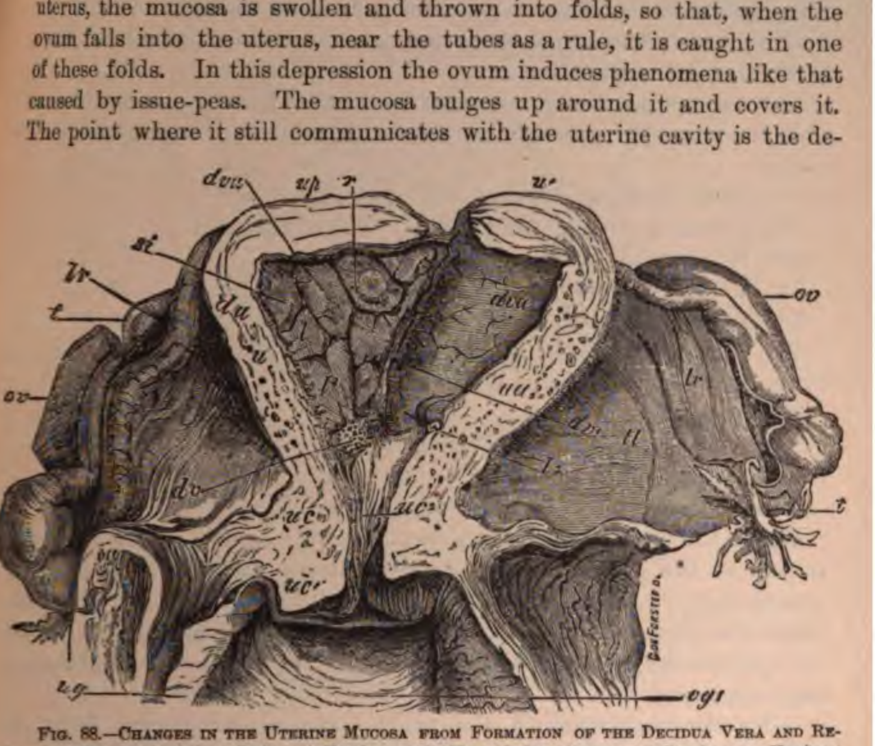


FIG. 88.—CHANGES IN THE UTERINE MUCOSA FROM FORMATION OF THE DECIDUA VERA AND REFLEXA (after *Reichert*.)—*u*, Body; *u'*, Fundus; *u''*, Sides of the uterus; *uc*, Cervix; *vg*, Vagina; *ov*, Ovary; *t*, Tube; *t'*, Pavilion of tube; *lr*, Round ligament; *up*, posterior wall of Uterus; *ua*, Anterior wall; *uc'*, Uterine orifice; *uc²*, Arbor vitæ; *dv*, Decidua vera; *dva*, Papillæ and cotyledons developed on the superior surface of the decidua vera; *l*, Islets of cotyledons; *r'*, Decidua reflexa; *si*, Groove separating the cotyledons.

1st. The growth of the ovum brings the ovular nearer to the parietal decidua. Thus, at the third month, the ovular decidua is everywhere in contact with the parietal mucosa covering the orifice of the tubes, and blending with the inter-utero-placental mucous membrane. The uterine mucosa seems to be one complete whole, but the ovular and parietal deciduæ are only in simple contact; they can be separated. The hydroperion, however, does not exist. At the fourth month, the two deciduæ become one membrane; and now the ovular decidua adheres to the chorion. Now also the villosities of the chorion reach their highest development at the inter-utero-placental mucous membrane.

The placenta forms, and the ovum has the definite structure that it presents when expelled.

Now also appears the new mucous membrane, loosening the old mucosa from the muscular layer of the uterus, thus truly changing it into decidua.

Structural modifications attend these changes.

The normal mucosa consists (Robin) of the following:

1st. Numerous follicles.

2d. A small number of special cells.

3d. Numerous embryo-plastic nuclei.

4th. Laminated fibres, at times embryonic (fibro-plastic bodies); at times, completely developed filaments.

5th. Amorphous matter.

6th. Vessels, nearly all capillaries.

7th. Prismoidal epithelium.

Now us let see what occurs in pregnancy.

Up to the formation of the placenta (second month), there is hypertrophy of the uterine decidua, every element partaking. Thereafter, hypertrophy concentrates in the inter-utero-placental mucosa, the place where the placenta is to form, while the remainder of the mucosa (ovular and parietal decidua) undergoes atrophy, so that the new membrane can easily replace it.

After the fourth month, the parietal and ovular mucosa form one membrane, shed with the ovum at birth, and replaced by a new uterine mucous membrane. (Fig. 88.)

In studying how these changes occur in the different elements we will follow Ch. Robin, who was the first to investigate them.

A.—Uterine Decidua.

a. *Changes in the Follicles.*—These increase in volume and number, so that the mucosa seems formed of tubes placed alongside one another perpendicular to its surface (or slightly inclined), but parallel one to the other. For one half their length they are straight, but near their round base they enlarge and undulate. They end in a cul-de-sac on the muscular layer, and open on the mucous surface by an orifice somewhat bell-shaped. They have a grey, granular cell wall, with longitudinal striations, lined or filled with an epithelium which is pale grey, angular or polyhedral. Externally, this epithelium forms a regular layer for the internal surface of the follicular tube.

When we squeeze the mucous membrane of the uteri of women who died early in pregnancy, a semi-fluid lactescent matter exudes, consisting of a viscid liquid, holding in suspension a number of fine granulations, partly fatty, and a large number of epithelial cells like those which fill the glandular tubes.

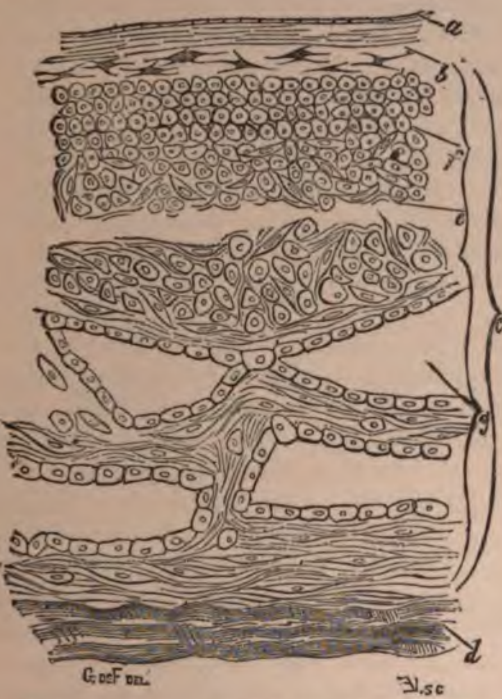


FIG. 89.—SECTION OF DECIDUA (after *Friedländer.*)—*a*, Amnion with epithelium; *b*, Chorion; *c*, Decidua; *d*, Muscularis; *e*, Dividing line of spindle cells; *f*, Layer of round cells; *g*, Glandular *culs-de-sac.*

b. *Changes in the Proper Cells of the Uterine Mucosa.*—During pregnancy, these cells so multiply that, in the third month, they predominate in the mucous membrane. Friedländer calls them decidual cells, and, when they are larger, giant cells; now they have different forms, according to their locality in the decidua. (Fig. 89). In the superficial layer, where they are compact, they are spherical; in the deep layer they are fusiform or spindle. The longest (Ch. Robin) are in the decidua reflexa. All have one or more nuclei. They are for replacing the uterine mucosa, which disappears during pregnancy (Friedländer), for this was made up of only two layers, a glandular and a special cell layer. These two are distinct layers, according to Friedländer; but de Sinety and others do not regard them as separable.

c. *Interglandular Tissue.*—The proper cells multiply, and embryoplastic nuclei appear in them, so that fusiform bodies and laminated fibres are lost to view in the mass.

d. *Vessels.*—The vessels of the mucosa, continuations from the muscularis, are usually larger than those of the latter. Where the mucous and muscular layers join, they form a kind of glomerulus, whence starts the capillary, which runs parallel with the glands, anastomosing with neighboring capillaries to form a species of plexus about the glands, without exactly touching them. At the surface of the mucosa they ramify in a mesh-work, whence springs a superficial capillary plexus.

The vessels are arranged differently at the level of the inter-utero-placental muçosa. These vessels, at first possessing walls of their own, have, at the end of gestation, only endothelium on a thin layer of connective tissue, which is not distinct from the adjoining tissue (Tarnier). At term, these disappear, by obliteration and atrophy, in the uterine decidua; while, on the other hand, they develop greatly in the inter-utero-placental mucosa.

e. *Epithelium.*—The epithelium of the ovular and uterine decidua changes from cylindrical and prismoidal into the pavement variety, not from transformation, but by exfoliation, and substitution of pavement cells, large and many-sided. At two and a half months, larger and longer cells join these, and, at term, the latter predominate. In spots, the epithelium is wanting; at term, we may only find it in limited patches.

B. OVULAR DECIDUA.

Identical changes with the above occur in the ovular decidua, for this is but the bulging of the uterine decidua around the ovum. The only difference is in the far more rapid development of the ovular decidua. More and more distended, and pushed towards the parietal decidua by the growth of the ovum, it differs therefrom, since, at the beginning of gestation, it is the point of implantation of the first villosities of the chorion. Otherwise, all the changes are as in the uterine decidua.

All the elements disappear as the ovular decidua thins on its approach to the parietal. In the middle of pregnancy, there remain only round cells mingled in a layer similar to that of the parietal decidua. At term, when it has joined with the last-named, it is only composed of one layer; but on the surface, adherent to the decidua parietalis, a number of epithelial cells can always be found. The decidua at the end of gestation is made up of three layers: an external layer, the parietal decidua; an internal layer, the ovular decidua; and, between them, an epithelial layer made from the union of the epithelium of the parietal and ovular decidua.

C. INTER-UTERO-PLACENTAL MUCOSA.

While the parietal and ovular deciduæ lose their elements, especially the vessels, the inter-utero-placental mucosa develops every element, especially the vessels to receive the villosities of the chorion, which are to form the placenta. The capillary vessels enter the mucosa, dilate and become sinuses, the walls of which disappear, thus forming lacunæ of blood in the mucosa; and into these sinuses the placental villosities dip. The serotina has, thus, a honeycomb or areolar appear-

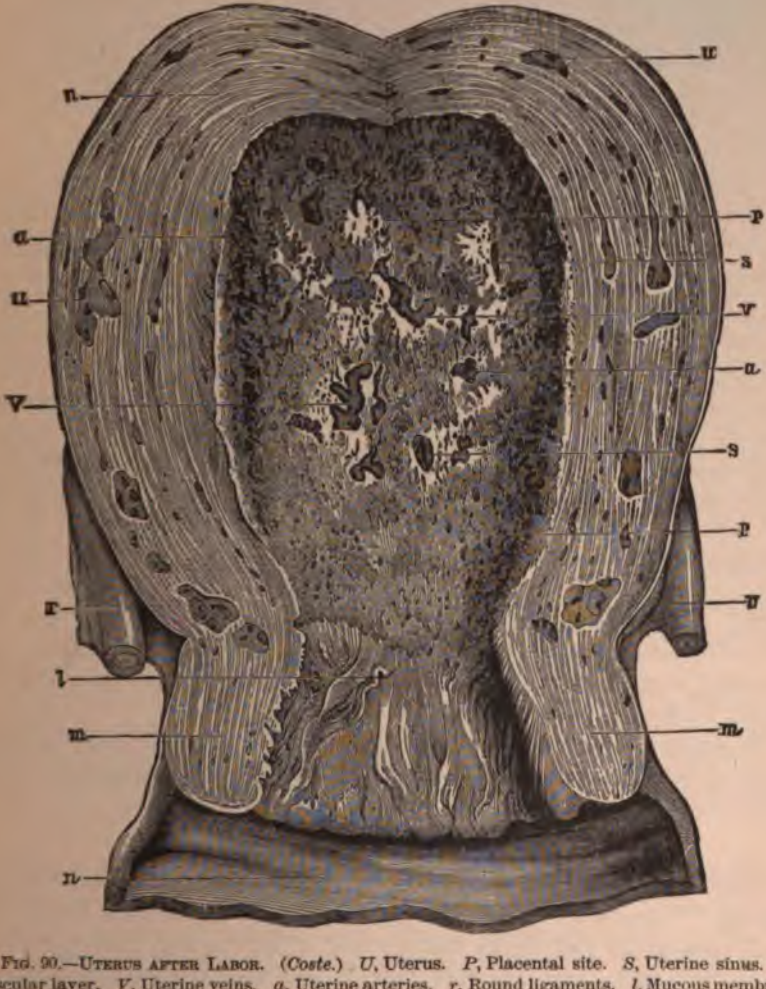


FIG. 90.—UTERUS AFTER LABOR. (*Coste.*) *U*, Uterus. *P*, Placental site. *S*, Uterine sinus. *m*, Muscular layer. *V*, Uterine veins. *a*, Uterine arteries. *r*, Round ligaments. *l*, Mucous membrane of cervix. *n*, Vagina. *t*, Uterine mucous membrane.

ance. These sinuses are continuous with those in the muscularis, but they anastomose about the placenta forming the circular sinus.

The uterine and ovular placenta first hypertrophy, and then atrophy; while the inter-utero-placental mucosa developes until the placenta is formed, and then remains stationary till delivery at term. All are not agreed on this point. Robin states that the uterine decidua is covered with epithelium until term; Friedländer says that it disappears, and that this decidua has a deep layer next to the muscular made up of glandular culs de-sac lined with epithelium, and a superficial, made of larger cells, both round and spindle-shaped. Fatty degeneration attacks all these elements at the end of pregnancy.

The ovular decidua becomes thin, and, Kölliker says, is formed, at the end of pregnancy, of round and fusiform cells which, later, become polygonal and fatty. Robin states that it is changed into a layer covered with epithelial *dèbris*. He also states that the inter-utero-placental mucosa preserves its epithelium until term. Kölliker and Friedländer state that the epithelium completely disappears at the end of pregnancy.

The next question is the fall of the decidua at childbirth. Robin states that from the fourth month of pregnancy the uterine decidua becomes loosened from the muscularis, because a soft, gelatinous membrane forms between them, that is, the new uterine mucosa. Hence, at delivery, the muscularis will not be left uncovered, but will have this new mucous membrane over it. Only the epithelial layer of the utero-placental mucosa will pass off with the placenta, the rest remaining adherent to the uterus.

The phenomena are identical in every part of the mucosa, according to Friedländer. He states that the layer of round cells disappears, the uterus being covered by the layer formed of deep, spindle cells and glandular culs-de-sac, not only over all the uterus, but even over the placental surface. The glandular layer gives origin to the new mucosa, which, he says, is formed only after delivery.

De Sinety does not think that there is a distinct line between the layer made of round cells, and that of glandular cells, but otherwise he agrees with Friedländer.

D. Mucous Membrane of the Cervix.

Robin states that this retains the structure which it had before pregnancy. There is a separation of its elements, the intervals being filled with transparent amorphous matter, with a paucity of granulations.

The superficial and sub-epithelial capillaries of the corporeal mucous membrane cease abruptly at the cervix.

Lott insists on peculiar epithelial changes. These consist in a change from the cylindrical to the pavement form, and in a multiplication, especially in the folds of the membrane.

The cervical mucosa is not a decidua, and hence, after delivery, is sharply distinguished from any new membrane.

IV. *Changes in the Uterine Vessels and Nerves.*

Arteries.—These increase in volume, length and even number. Jacquemier states that this increase in length is not from straightening out of folds, since the vessels are as tortuous at the end of pregnancy as before it. The uterine arteries are a little larger than the ovarian. Forming an extensive plexus in the broad ligaments, these vessels suddenly increase in volume as they penetrate the uterus at its sides. They are nearer the peritoneal than the mucous surface, except in the placental region; and they anastomose with each other and with their fellows of the opposite side. Large numbers pass in until they reach the mucosa where they end in a capillary plexus. Those that go to the inter-utero-placental mucosa are longer and larger than the others, and are called utero-placental arteries. They all have fibro-cellular sheaths; and the capillaries communicate with the veins.

Veins.—These grow very large. The ovarian veins (Jacquemier) exceed in diameter, by 1.17 to 1.5 inches, that of the internal or external iliac vein. Deep in the uterine tissue they form uterine sinuses which intercommunicate. According to Kölliker, besides their normal muscular layer with broad circular fibres, they have an internal and external muscular layer with longitudinal fibres. Their walls are thus very thick. Kölliker's views are not now accepted: all believe that the uterine sinuses have a single internal tunic. Kölliker's fibres are but muscular tissue adhering to the veins, changing them into contractile canals. None have valves.

Near the placenta, a great number of these canals approach the internal layer, and are separated therein by a very thin layer of uterine tissue, or only by the mucosa, when they penetrate in the utero-placental mucosa and enter the placenta; they are the utero-placental veins.

The sinus of the middle layer receives veins from the internal and external layer, and from the decidua, thus changing the uterus into a cavernous organ; hence the abundant hemorrhage at the moment of delivery.

We have already sufficiently discussed the lymphatics and the nerves.

PROPERTIES OF THE UTERUS DURING GESTATION.

Pajot is right in contradicting Cazeaux's statement that in pregnancy the uterus has entirely new properties, for gestation only "increases obscure and latent properties, that certain physiological or pathological events foreign to pregnancy may make perceptible, so that there is no doubt as to their permanence." (Pajot.)

These properties are five: contractility, retractility, irritability, sensibility and elasticity.

1st. *Contractility.*—This is the great property, due of course to the muscular structure, and possessed in common with all hollow organs. The uterine fibres can actively draw together, diminishing the size of the cavity, and after a certain time can assume the original dimensions. Uterine contraction is the manifestation of this contractility.

Contractility exists in every muscular fibre, but is far more developed in the fundus and body than in the cervix.

This property, rudimentary when the uterus is empty, appears in some women at the menses, in cases of dysmenorrhœa, particularly membranous dysmenorrhœa, polypi and fibroids; but it only reaches its culmination during pregnancy, from the great muscular development at that period. It is greatest at the moment of delivery; and it does not cease till after death, for cases are recorded where the uterus has expelled the child after death of the mother.

Although completely involuntary, uterine contraction is not necessarily painful, as is proven by the painless contraction often experienced towards the end of pregnancy (this constitutes the concealed or secret labor of Millot and older authors). Usually, uterine contractility is accompanied with pain: hence the expression "a woman in the pains of labor."

Pains and uterine contractions are terms indifferently used by authors. The pains differ in degree in different women; and may be absent. I had two well-marked cases where there were no pains.

Although involuntary uterine contraction is under nervous influence, and emotion can either suspend or induce it, it may be called into play or modified by different agents. Direct applications to the cervix (tampon, douche or dilatation), friction, massage, cold or heat applied externally, provoke contractions, which also are induced by twin pregnancy, hydramnion, death of the fœtus, electricity, ergot, rue and savin; while opium in sufficient doses slows or suspends uterine contractility. Chloroform, chloral and anæsthetics act in the same fashion.

How the nervous system acts, physiology does not tell us. Both the cerebro-spinal and sympathetic systems play a part, but the latter the greater. If Oser and Schlesinger have proved that there is in the medulla oblongata a centre for uterine activity exactly similar to that which corresponds to automatic movements, it is evident that the motive power of the uterus is not called into play by central irritation, but, rather, by reflex action. The experiments of Scanzoni amply prove this; he induced delivery by applying cups to the breasts. The experiments of Kilian Spiegelberg, Kehrer, Frankenhauser, Obernier and Körner are contradictory, as also are clinical observations. But the influence of the spine over uterine contractility cannot be denied, for in women who have paraplegia, uterine contractions, if less painful, are also very feeble. And, if a few such have easy delivery, yet, in the majority, labor is tedious from feeble uterine contractions.

Brown-Séquard states that uterine contraction is due to irritation by carbonic acid, with which the venous blood is loaded. (See Causes of Delivery.)

Like all muscular action uterine contractility is intermittent; and it becomes weak and exhausted when it meets too much opposition. It may persist after death. It may be regular or irregular, diminished or increased.

2d. *Retractility.*—"This," says Pajot, "is that property of uterine tissue by virtue of which the uterus, emptied of a part of its contents, acquires a greater thickness of its walls, while the volume and capacity diminish." It differs from contractility in as much as it is permanent, and not intermittent, and is in inverse proportion to the distension the uterus has undergone. It aims to maintain direct contact between the ovum and the uterine walls, and to prevent hemorrhage by closing the gaping vessels after delivery of the placenta, and by holding the uterus in the condition it assumes after parturition.

It is painless, but may lead to spasm or inertia of the uterus, and thus induce grave results. Besides, it is not the same in every part of the organ.

It is best marked in the fundus and in the body, and almost *nil* in the cervix; hence the gravity of hemorrhage in placenta prævia.

Diminished, weakened or exhausted, by great distension of the uterus, it may be reinduced by cold, massage and direct excitation of the uterus; but its action ends immediately after delivery, and, as Pajot says, it is not retractility which brings the uterus back to its normal state, but a process of absorption and atrophy, which processes depend upon the health of the woman, since the first effect of puerperal disease is to suspend this work of absorption.

3d. *Irritability.*—This may be called an impressionability of the uterus which varies in different patients, and shows itself by a more or less prompt tendency to contract, to react against the exciting causes. It is marked in some women, and absent in others: hence the frequency of abortion from insignificant causes in the former, and the incredible resistance of pregnancy in the latter.

4th. *Elasticity, Extensibility.*—While Pajot leans toward the admission that elasticity is the result of combined retractility and extensibility, Tarnier and Chantreuil confound the terms elasticity and extensibility.

Whatever be its name, it is from this property that the uterus can be distended by the ovum, preserving that suppleness which is so different from flaccidity. Except in great distension (twins, and dropsy of the amnion), extensibility and elasticity never attain their maximum; hence the child can move *in utero* either spontaneously, or when version is attempted.

5th. *Sensibility.*—This is slightly developed in an empty uterus, and the cervix may even be burnt with red-hot iron without the woman having any pain; but it increases during pregnancy, although to no great extent. It is more marked in the body than in the cervix, and the child moving, as well as uterine contraction, causes pain. It varies in different women; and, except in primiparæ, increases with age. Our observations lead to the conclusion that the pains of labor are much severer and far more ill-borne by primiparæ who are over thirty, than by young women.

4. Changes in the Appendages of the Genital Apparatus.

The broad and round ligaments, the ovaries and the tubes, also undergo organic and functional changes.

1st. *Broad Ligaments.*—The uterus steadily tends to separate their two peritoneal folds as it enlarges. Carried upward by the uterus, they become hypertrophied along with the serous covering of the organ and exhibit hyperplasia.

At the same time they become vertical.

2d. *Round Ligaments.*—With the uterus they undergo hypertrophy, and form two large cords which, from the great development of the posterior uterine wall, are no longer inserted into the lateral wall, but at the union of the posterior four-fifths and the anterior one-fifth of its lateral surfaces.

3d. *Ovaries.*—They rise in the abdominal cavity with the broad ligaments, and, becoming vertical, almost touch the uterus. Ovulation ceases, while the Graafian vesicle, whence came the ovum, which was the starting point of gestation, undergoes phenomena of cicatrization called the corpus luteum of pregnancy.

The ovaries increase in size.

4th. *Tubes.*—The Fallopian tubes undergo hypertrophy with the uterus. Their muscular tissue increases and their epithelium loses its ciliæ, becoming nucleated. Robin describes a yellowish white fluid in the tubes composed of a viscid liquid holding in suspension nuclei of epithelium, and fatty granulations without leucocytes.

5th. *Mammary Glands.*—Besides the structural changes that we have described in the anatomical portion of this work, the mammary glands suffer external changes during gestation, which are, as we will see, of prime importance in the diagnosis of the first pregnancy. These are:

a. Swelling and enlargement manifest themselves in the first few weeks, and, generally, there is experienced, at the same time, a feeling of tingling and painful tension in them. The veins enlarge, and, if the mammary swelling is considerable, we will find ecchymoses or wheals such as are found on the abdomen, thighs and buttocks. Towards term, colostrum appears; this can easily be pressed out by squeezing the nipple, which is now large, dark, sensitive and erectile.

b. The areola undergoes important changes. Its color changes: very dark, almost black, in brunettes; moderately dark in blonde women; it is slightly, if at all, changed in women with red hair. The areola enlarges and bulges, at times looking like a watch-glass upon the breasts.

Ten to twelve tubercles, tubercles of Montgomery, appear on this areola; a fluid identical with colostrum can be squeezed from them. To-day they are thought to be little rudimentary mammary glands. Around the primary, or true, areola, there forms, especially in brunettes, a second, wider, more indistinct areola, which starts from the primary, and finally merges into the skin of the gland. It has a somewhat mottled look, due to a number of little white spots, bounded by brown lines; hence the name mottled or spotted areola. At the middle of every white spot is a little black dot, which is but a little hair, as can be verified though a magnifying glass.

6th. *Abdominal Wall.*—The growing uterus distends the walls; vertically this extension may be 2.7 inches, and extensive changes occur in the musculo-aponeurotic layer in consequence.

The umbilicus, sunken for the first two months of pregnancy from falling of the gravid uterus, gradually disappears as gestation progresses. Its fundus approaches its sides, and at the seventh month it is on a level with the rest of the skin. Henceforth, it becomes more and more projecting.

The umbilical ring dilates so that, at times, the finger may be introduced in it.

The skin is fissured, looks chafed and is covered with wheals, especially in the sub-umbilical and inguinal regions. These wheals, reddish or bluish, are striated during pregnancy, and do not disappear at delivery, but become white, like old scars, and thus can be distinguished from those arising during another pregnancy. Caused by great distension of the skin, and the ecchymoses produced in the derma, they may appear in a non-pregnant individual, where there has been rapid and great distension of the skin.

Pigment is deposited in a line, the dark, or brown line, which runs from the pubes to the umbilicus, which it surrounds, and a little beyond this point, in most women. It is constant in brunettes, but not well marked in blondes; it may be wanting in red-haired women. In some very dark women the whole abdomen, and the upper part of the thighs, are a more or less deep brown from deposit of pigment.

In the musculo-aponeurotic layer the greatest distension is at the linea alba; this may become 3.9 to 4.2 inches long, and the two recti muscles may be separated by a considerable space. If, when the woman is in bed, she be made to throw back her head and chest a little, there is a more or less marked projection between the recti muscles, which has received the name of eventration; the borders of each rectus muscle may then be felt, and an exact idea obtained of the muscular relaxation. When this is exaggerated a girdle is necessary. When eventration is marked, the uterus, no longer supported by the abdominal wall, pushes before it the linea alba producing the pendulous belly (*ventre en besace*).

Pigmentation may also occur on the face; it is then called the mask.

ORGANIC AND FUNCTIONAL CHANGES IN OTHER THAN THE REPRODUCTIVE ORGANS.

There is no system in woman that is not modified by pregnancy. We will study each one in succession.

Digestive Apparatus.

Compression phenomena here predominate. The growth of the uterus crowds the intestines and stomach, diminishing their freedom of motion, so that we often witness, at the end of pregnancy, the reappearance of vomiting, which is dependent entirely upon pressure on the stomach. The intestines may escape compression by occupying space at the side of the uterus; but the rectum, being behind it, is always compressed, and this is exaggerated by the constipation which is habitual in pregnancy. Hence masses of fæces collect, and so bulge the vaginal wall that inexpert observers have mistaken such a tumor for the fœtal head. Similar compression on the rectal veins induces hemorrhoids.

Tarnier has described the liver as fatty, but, as this can only be proved at the autopsy of patients dying of puerperal fever, many think that this is a pathological, rather than a physiological phenomenon.

The experiments of de Sinety on animals seem to prove the reverse, however. The fat accumulates in the centre of the lobule, and is scanty or absent at the periphery. Now, in pathological cases, the disposition of fat is just the reverse.

From the beginning of pregnancy, the digestive functions are altered. They are (Pajot) increased, diminished, perverted or perturbed. We will study these later. Although constipation is the rule, in many cases profuse diarrhœa alternates with it. Like vomiting, the diarrhœa may become pathological and uncontrollable.

Pregnant women increase in weight.

The experiments of Hecker and Gassner (of Munich) conclusively prove this. The latter states that the increase shows itself in the last three months, being 3½ to 5½ pounds for each month, except when the fœtus dies. Gassner attributes it not only to the growth of the ovum and the uterus, but to a universal increase in the organism, the result of greater activity in the functions of assimilation.

Circulatory Apparatus.

The quantity and quality of the blood are changed, as well as the heart and vessels.

The former of these changes have been investigated by Spiegelberg, Gecheidlen and Nasse.

The first two of these authors, experimenting on animals, arrived at the following conclusions:

1st. The blood-mass increases during pregnancy, but only after the fourth month.

2d. The amount of hæmaglobin depends on the animal's nourishment.

3d. Increase in watery constituents, if it exist, is insignificant.

Andral and Gavarret were the first to investigate the composition of the blood; and their results have been confirmed by Becquerel, Rodier, Regnault and Nasse.

They prove that the pregnant female is not plethoric, anæmic or chlorotic. The latter condition is ascribed to her by Cazeaux; but the blood during gestation is peculiar; there is increase in water and diminution in red corpuscles, iron and albumin. For the first six months the fibrin diminishes; for the remaining three it increases.

The following tables, one from Becquerel and Rodier, and the other from Regnault, give a *resumé* of the blood condition in pregnant women:

ANALYSIS OF BLOOD IN PREGNANCY. NINE WOMEN.

	Average.	Maximum.	Minimum.
Density of defibrinated blood	1051.5	1055.1	1046.2
“ “ serum . .	1025.5	1026.8	1023.6
Globules	111.8	127.1	87.7
Water	801.6		
Albumin	66.1	68.8	62.4
Fibrin	3.5	4.	2.5
Extractives and free salts .	6.6	8.7	4.7
Fatty matter . . .	1.922	2.519	1.158
Serolin	variable	0.108	0.018
Fatty phosphorated matter .	0.646	8.863	0.381
Cholesterin	0.061	0.225	0.030
Soap	1.195	1.323	0.737

IN 2⅕ POUNDS OF DRIED BLOOD.

	Average.	Maximum.	Minimum.
Chloride of sodium	4.8 grains.	5.8 grains.	3.5 grains.
Soluble salts .	3.5 “	4.2 “	2.70 “
Phosphates . .	6.45 “	10.35 “	4.2 “
Iron . . .	6.75 “	7.35 “	5.5 “

ANALYSIS OF BLOOD OF A HEALTHY MAN.

	Average.	Maximum.	Minimum.
Density of defibrinated blood	1060.	1062.	1058.
“ “ serum . . .	1028.	1030.	1027.
Water	779.	760.	800.
Globules	141.1	152.	131.

	Average.	Maximum.	Minimum.
Albumin	69.4	73.	62.
Fibrin	2.2	3.5	1.5
Extractives and free salts	6.8	8.0	5.
Fatty matter	1.600	3.255	1.000
Serolin	0.020	0.080	
Fatty phosphorated matter	0.488	1.000	0.270
Cholesterin	0.088	0.175	0.030
Soap	1.004	2.000	0.700

In 2⅕ Pounds of Dried Blood.

	Average.	Maximum.	Minimum.
Chloride of sodium	4.6 grains.	6.3 grains.	3.4 grains.
Soluble salts	3.7 “	4.8 “	3.0 “
Phosphates	4.9 “	1.0 “	3.2 “
Iron	8.4 “	9.4 “	7.5 “

We must notice, also, the cardiac and vascular changes. Larcher was the first (1857) to describe cardiac hypertrophy in pregnancy. The left ventricle is the only part involved in this process. Ducrest has confirmed this: he examined 100 hearts of women who died in childbirth, and found the walls thicker by $\frac{3}{5000}$ths of an inch. Blot found the heart about 900 grains heavier.

Jacquemier heard a murmur in 25 per cent. of 257 cases he examined.

The arteries and veins undergo changes in pregnancy, that manifest themselves by a frequency and hardness of the pulse, and compression of the veins inducing varices, œdema and hemorrhoidal tumors.

Respiratory Apparatus.

The changes are either mechanical or chemical.

1st. *Mechanical Changes.* — Kuchenmeister, Fabius, Wintrich and Dohrn state that during pregnancy the base of the thorax widens, while the vertical and antero-posterior diameters diminish. The reverse occurs after delivery. They say that this diminution and increase compensate one for the other, and that the capacity of the thorax is unchanged. Tarnier and Chantreuil deny this last, and state that, the diaphragm being pushed upward, and not being able to descend as far as usual, there is a diminution in the cavity, as is proved by the kind of respiration, and the dyspnœa of pregnant women upon exertion. This dyspnœa is greatest in women with deformed pelvis, or abnormal spine. Again, this dyspnœa abates in the last few days of pregnancy, as the fœtus engages and the fundus uteri sinks.

2d. *Chemical Changes.*—Andral and Gavarret prove that, during all of pregnancy, the amount of carbonic acid exhaled increases daily. A similar phenomenon occurs at the menopause, and at each menstrual epoch.

Urinary Organs.—Urinary troubles arise from compression of the bladder, displacement of the urethra, causing dysuria, sometimes cystitis, and very often, an incessant desire to urinate, which most pregnant women experience even when there is no cystitis.

The kidneys are compressed and congested, and this congestion may lead to albuminuria.

The urine shows increase in water and chlorides, while the phosphates, sulphates, urates, uric acid, creatin and creatinin diminish in proportion as pregnancy advances. Kyestein, described by Nauche, Eguisier, Tanchon, Stark, Letheby and Kane, has been relegated to obscurity by the experiments of Regnault, Cazeaux, Hœfle and Scanzoni.

It is proven that this pellicle, which forms on the surface of still urine at the end of thirty-six hours, is composed simply of crystals of ammonio-magnesian phosphate with vibrios and monads, and that it may even make its appearance in man's urine.

It is quite otherwise concerning the presence of sugar in the urine of pregnant women, of those who are just delivered and in those who are nursing.

This was described by Blot in 1856, and was proven by Leconte and Keisten; but it appears to be less frequent than Blot claimed. Hempl and Gubler have quite recently called attention to this.

Cutaneous System.—Here we find pigmentary deposits, or the uterine chloasma, pityriasis versicolor, wheals and diminution in the thickness of the nails (Esbach). Beau has described the diminution in growth (in length) of the nails during the diseases of pregnancy. We also find eruptions, acne and prurigo.

Nervous System.—Here we find neuralgia, toothache, headache, derangements of the special senses—especially taste, smell and sight—and finally, psychical changes.

The Osseous System.—Without referring to relaxation of the symphyses and of intimate changes in the bone, we must mention that some women, who have married very early in life, grow during pregnancy, especially after delivery. The bones of the extremities increase in length, and a substance resembling bone tissue is deposited, in the majority of pregnant women, between the internal table of the cranial bones and the external surface of the dura mater, especially around the sinuses:—these are cranial osteophytes.

Rokitansky, in 1838, described these osteophytes, and, in 1844, Ducrest and Moreau were the first in France to find them. The latter has proved that they are not found solely inside of the skull. In 98 cases of women who died at the *Maternitè* during childbirth, 42 showed intra-cranial osteophytes and 12 osseous plates on the exterior of the skull.

In these twelve cases the intra-cranial osteophytes were very well developed.

Follin and Claude Bernard found osteophytes, like those of the cranium, in the pelvis of women who had died in childbirth.

CHAPTER II.[1]

IMPREGNATION AND CONCEPTION—GENERAL ACCOUNT OF MAMMALIAN DEVELOPMENT.

IN the ovum itself, about the time of attaining maturity, certain changes of great importance occur. Owing to the extreme difficulty of obtaining material at the proper time and in suitable condition for microscopic investigation, these changes have not yet been seen to occur in the human ovum; but inasmuch as they are now known to take place in nearly all the groups of invertebrate animals, and have also been described, though less completely, in fish, amphibians, and mammals, there is hardly any room for doubting that they occur in man also.

These changes, which appear to take place in mammals about the time of rupture of the Graafian follicle and escape of the ovum, are best known to us through the researches of Ed. van Beneden on the rabbit's ovum. The ovum first contracts slightly, so that it no longer completely fills the zona pellucida (*vide* Fig. 91). The germinal vesicle, which had previously occupied a central or only slightly eccentric position, now travels to the surface of the ovum; the delicate membrane enclosing the germinal vesicle disappears, and the contents of the membrane—*i.e.*, the nuclear reticulum and the germinal spot—become modified so as to form what is called the nuclear body, which is situated within the ovum, but close to its surface. A little later, part of this nuclear body is ejected from the egg, and forms two small "polar bodies" (Fig. 91) lying in the space between the zona pellucida and the ovum, formed by the shrinking of the latter, as already noticed.

Van Beneden held that the whole of the nuclear body was bodily extruded from the egg; but from the analogy of other animals it is in the highest degree probable that only a portion is extruded, and that the remainder stays within the egg, and, travelling towards its centre, forms what is called the female pronucleus.

The upshot of this process is, practically, that the germinal vesicle moves from the centre to the surface of the egg, and that, after undergoing certain changes, part of it is bodily extruded from the egg while the remainder stays within it. The change is an exceedingly important one, because it appears that, after the polar bodies are extruded, the ovum loses all power of further development. We have seen above that the ovum is a single cell, which originally formed part of the germinal epithelium, and that the germinal vesicle and germinal spot bear the same relation to the whole ovum that the nucleus and nucleolus do to an ordinary epithelial cell. Now, in the ordinary process of multiplication of cells by division, the nuclei are known to play a very important part; when a cell is about to divide into two the nucleus divides first, so that we have a stage in which there is a single cell with two nuclei, and then, later on, the whole cell divides into two halves, each containing half of the original nucleus. From this it appears that the nucleus is the part of the cell specially concerned with the process of reproduction or multiplication, and the part in which that process is initiated.

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[1] [In part, slightly condensed from Barnes's "System of Obstetric Medicine and Surgery."—ED.]

The formation of the embryo from the ovum is, as we shall see immediately, essentially a process of cell multiplication by division, in which the nucleus of the ovum plays exactly the same part as the nucleus of an ordinary epithelial cell. An ovum with an entire germinal vesicle or nucleus must be supposed to have in itself the power of multiplication by fission, and so of producing an embryo, and, as we see in the case of many insects, such an ovum has actually this power; but after the extrusion of the polar bodies, the ovum is left with an imperfect nucleus, and is no longer capable of multiplication, unless the portion of the nucleus that has been extruded is replaced.

FERTILIZATION OF OVUM.

On arriving at the ovum the spermatozoa bury themselves in the zona pellucida, and in Fig. 91 a number of them are shown in this position. One of them goes further; its head penetrates into the ovum itself, and separates from the tail, which remains outside and ultimately disappears. The head, once inside the ovum, increases in size, assumes a radiate appearance, and is known as the male pronucleus. The male and female pronuclei—the latter, it will be remembered, being the portion of the original germinal vesicle which has remained in the ovum—now gradually approach one another, and ultimately fuse to form the definite nucleus of the fertilized egg.[1]

After the formation of this definite nucleus, the ovum regains the power of multiplication by fission, which it had previously lost by the formation of the polar bodies; in other words, the act of impregnation consists in the replacement by the head of the spermatozoon of that portion of the original germinal vesicle, or nucleus of the ovum, which had at an earlier stage been extruded bodily from the ovum in the form of the polar bodies.

It has been stated that primitive ova occur in the male as well as the female embryo. In the female they become converted, as already explained, into the permanent ova; and in the male they give rise by a series of changes to the spermatozoa; so that from these primitive ova the essential reproductive elements of both sexes are derived; the main difference between them being, that while in the female each primitive ovum becomes a single permanent ovum, in the male each primitive ovum gives rise to a considerable number of spermatozoa.

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[1] All the details of this process have not yet been seen in the mammalian ovum, but the analogy of lower animals leaves little room for doubt that the above description is correct in all essential points.

We thus see that the male and female elements, the spermatozoa and ova, are fundamentally very similar to one another; and if we reflect further that the head of the spermatozoon is almost entirely made up of its nucleus, derived by repeated division from the nucleus of the primitive ovum, we shall see that in the fusion of female and male pronuclei we have really the fusion of a portion of the nucleus of a permanent ovum, which is itself derived from the nucleus of a primitive ovum, with the nucleus of a spermatozoon which is also derived by fission from and is therefore a part of a nucleus of a primitive ovum; *i.e.*, that the fusion is between two parts of very similar morphological value.

If we inquire further as to the cause of this process of impregnation, the answer is probably to be found in the great advantage as to vigor of the progeny which is known to accrue to both animals and plants from cross-fertilization as contrasted with self-fertilization; it may even be, as suggested by Balfour, that the habit of forming polar bodies—*i.e.*, of providing that development cannot possibly occur without impregnation, has been acquired and perpetuated for the express purpose of insuring that cross-fertilization should be the invariable rule.

As to the number of spermatozoa necessary to insure fertilization, or normally taking part in it, our knowledge is very imperfect. From observations on the lower animals it would appear that a single spermatozoon is sufficient, but that more than one may be concerned in the act.

GENERAL ACCOUNT OF MAMMALIAN DEVELOPMENT.

The earliest stages in the development of the fertilized human ovum have not yet been seen at all, and several of the later stages are only very imperfectly known. Inasmuch as a general knowledge of these early and intermediate stages is absolutely essential to the proper understanding of the structure of such early human embryos as have been described, a short general account of the leading features in the development of mammalian animals will be useful here, while the development of the human embryo itself will be dealt with later.

Segmentation of Ovum.

The changes that immediately follow impregnation are best known to us through the researches of Bischoff and Van Beneden, as they occur in the rabbit. The ovum is fertilized in the upper part of the Fallopian tube, down which it travels slowly to the uterus, which it reaches in three days. During its passage it is still invested by the zona radiata, and receives, in addition, from the walls of the tube, an outer albuminous envelope. The changes that are undergone by the ovum during its passage down the Fallopian tube are commonly spoken of as the segmentation of the ovum, and are of the following nature:

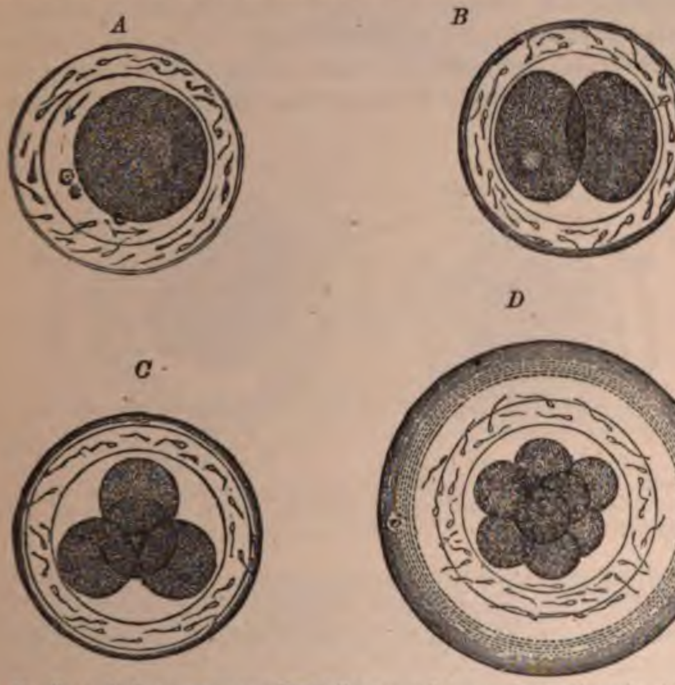

FIG. 91.—RABBIT'S OVUM, WITH THE THREE STAGES IN SEGMENTATION. (From *Quain's Anatomy*, after *Bischoff*.) *A*, Numerous spermatozoa are seen embedded in the zona. In the space between the zona and the yolk, caused by the shrinking of the latter consequent on impregnation, are seen two polar bodies. *B*, Shows the division of the ovum into two nearly equal masses. *C*, The formation of four spheres by division of the two of the proceeding stage. *D*, The stage with eight segmentation spheres.

A few hours after fertilization is effected the whole ovum divides into two very nearly equal portions (Fig. 91, B); a little later each of the two divide again, and then each of the four; so that we get, in place of the original single sphere (Fig. 91, A) eight spherical bodies, of which four are slightly larger than the other four (Fig. 91, D). Each of the eight again dividing, we get sixteen, of which the eight larger ones—which we shall speak of as epiblast cells—become arranged round and partially enclose the eight smaller or hypoblast cells. Both sets of cells go on multiplying, and at about the end of the third day after impregnation, when the ovum passes from the Fallopian tube into the uterus, it has the structure shown in Fig. 92, A. It is still spherical, .3 inch in diameter, and very little, if at all, larger than at the time of escape from the Graafian follicle; but instead of being one single cell, it consists of an outer layer of epiblast cells, almost completely surrounding a central mass of hypoblast cells.

This phenomenon of segmentation, always the first process in the development of an egg, is clearly a process of cell multiplication by fission; and it is almost certain that the nucleus plays the same part here that it does in ordinary cell division—*i.e.*, that before the whole ovum divides into two the nucleus divides first, and that at every subsequent division the nucleus divides before the cell itself, so that the nuclei of the cells shown in Fig. 92 are derived by fission from that of the fertilized ovum.

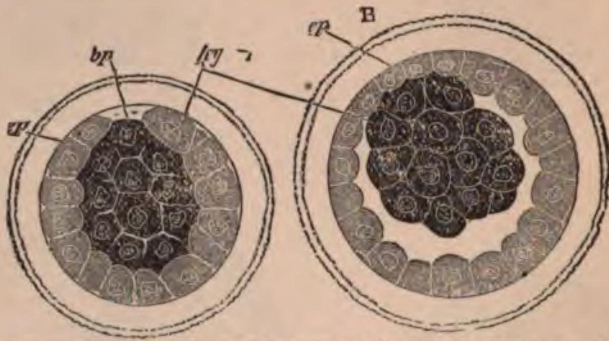

FIG. 92.—OPTICAL SECTION OF RABBIT'S OVUM AT THE CLOSE OF SEGMENTATION. (From *Balfour*, after *Ed. van Beneden*.) *ep*, Epiblast. *hy*, Primitive hypoblast. *bp*, Spot where the epiblast has not yet grown over the hypoblast.

If we consider that the ovum is a single cell, and that from that single cell the embryo, with its various tissues, epidermis, muscle, nerves, etc., themselves all composed of cells, has to be derived, we shall not be surprised to find that the very first thing the ovum does in developing is to give rise by fission to a heap of cells—to convert itself from a unicellular to a multicellular condition.

The Blastodermic Vesicle.

Having reached the uterus, the epiblast cells first grow over the hypoblast cells so as to enclose them completely, and then a narrow cavity, crescentic in section, appears between the epiblast and hypoblast (Fig. 92, B), extending nearly, but not quite, all round. The epiblast, and consequently the whole ovum, now grows very rapidly, and during the fourth day acquires the appearance shown in Fig. 93. It is now a thin-walled spherical sac, about one inch in diameter—the so-called blastodermic vesicle. Its wall consists of a thin layer of flattened epiblast cells, and attached to its inner surface at one part is a lenticular mass formed by the hypoblast cells. If the ovum be looked on from above, this patch of hypoblast will give rise to an opaque circular spot—the embryonic area.

The blastodermic vesicle still continues to grow rapidly; the circular patch of hypoblast also grows all round its edge, and so extends further and further round the inside of the vesicle; and in the embryonic area a third layer of cells—the mesoblast—appears between the epiblast and hypoblast. The appearance of the blastodermic vesicle on the seventh day is shown in Fig. 94. The central white spot is the embryonic area; this is now somewhat pear-shaped, and consists of all three layers of cells—epiblast, mesoblast, and hypoblast. The rest of the upper half of the

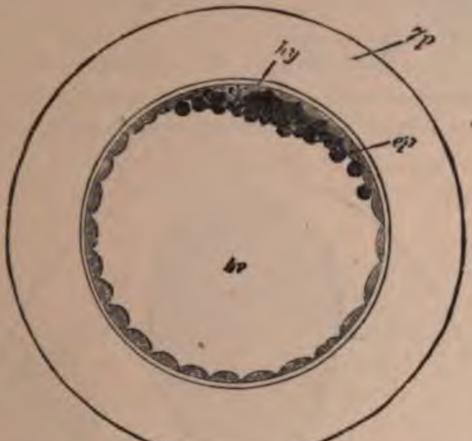

FIG. 93.—RABBIT'S OVUM BETWEEN SEVENTY AND NINETY HOURS AFTER IMPREGNATION. (From *Balfour*, after *Ed. van Beneden.*) *bv*, Cavity of blastodermic vesicle. *ep*, Epiblast. *hy*, Primitive hypoblast. *zp*, Zona pellucida.

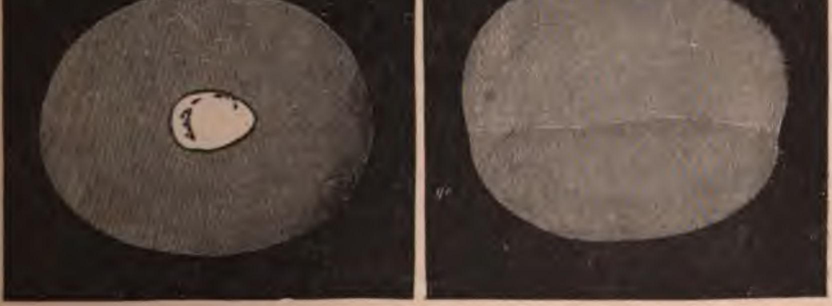

FIG. 94.—DIAGRAMMATIC VIEWS OF THE BLASTODERMIC VESICLE OF A RABBIT ON THE SEVENTH DAY. From (*Balfour*, after *Ed. von Beneden.*) In the left-hand figure, the vesicle is seen from above: in the right-hand figure, from the side. The white patch (*ag*) is the germinal area; and the slight constriction (*ge*) marks the limit to which the hypoblast has extended.

vesicle consists of two layers, epiblast and hypoblast, the slight constriction round the middle of the vesicle, seen in the right-hand figure, marking the limit to which the hypoblast has extended; and, finally, the lower half of the vesicle, below the constriction, consists of epiblast alone. The whole vesicle is still invested by the zona pellucida, which is not shown in the figure.[1]

Formation of the Embryo.

During the seventh day a narrow opaque patch—the *primitive streak*—appears in the posterior half of the embryonic area; and in front of this

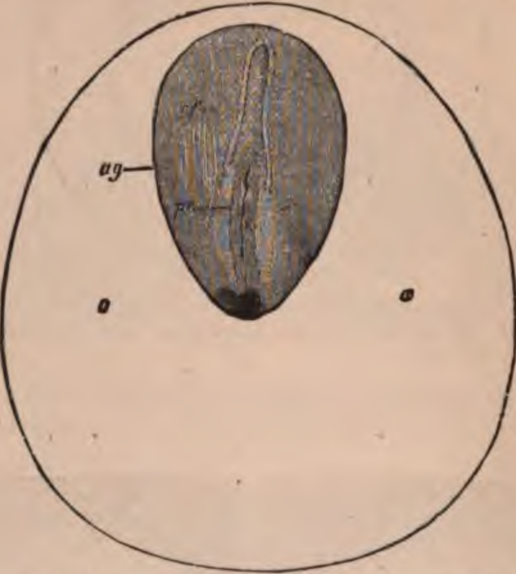

FIG. 95.—EMBRYONIC AREA OF A RABBIT'S OVUM OF THE SEVENTH DAY. (From *Kölliker*.) The shaded part (*ag*) is the embyronic area. *OO* is the region of the blastodermic vesicle immediately surrounding the embyronic area, into which the mesoblast has already spread, and in which blood-vessels will shortly appear. *pr*. Primitive streak. *rf*, Medullary groove.

streak there is formed, on the eighth day, a shallow median groove—the medullary groove (Fig. 95), bounded by two folds—the medullary folds.

This groove rapidly deepens; the two folds bounding it bend over towards one another, meet and fuse, thereby converting the groove into a closed tubular canal—the neural canal—which is the rudiment of the central nervous system, one of the very earliest systems to appear in the embryo, and which becomes differentiated into the brain in front and spinal cord behind. From the mode of its formation—at first an open groove—it is clearly lined by, and indeed formed from, the epiblast, the most superficial of the three layers of the embryonic area.

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[1] The actual formation of the three germinal layers of the rabbit is probably not so simple as is described above, and is not yet thoroughly understood. According to Balfour and Keepe, the "hypoblast" cells of Figs. 92 and 93 divide into two layers, whereof the upper fuses with the epiblast, of which it becomes part, while the lower layer remains as the definite hypoblast of the embryo. The mesoblast, which appears later than the other two layers, is formed partly from epiblast and partly from hypoblast.

At the sides of this medullary or neural canal, about the ninth day, the mesoblast becomes divided into a number of somewhat cubical masses arranged in a linear series on either side of the middle line; these masses (Fig. 96) are the protovertebræ, and the transverse lines between them mark the division of the body into segments or somites.

We thus see that the formation of the embryo commences in the embryonic area of the blastodermic vesicle; and, further, that if the vesicle be placed with the embryonic area upwards, as in the right-hand figure of Fig. 94, then the dorsal surface of the embryo, indicated by the central nervous system, will be directed upwards; and the ventral surface downwards—*i.e.*, towards the cavity of the blastodermic vesicle. The head end is indicated in Fig. 96, by the dilatations of the neural canal

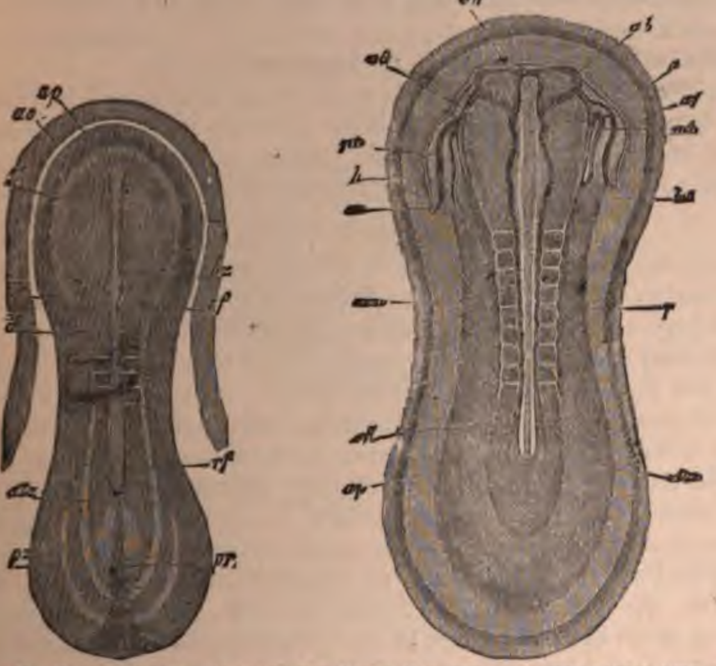

FIG. 96. RABBIT EMBRYOS OF ABOUT THE NINTH DAY, SEEN FROM THE DORSAL SIDE.—(From *Kölliker*.) *ab*, Optic vesicle. *af*, Amnion. *ap*, Area pellucida. *h* and *hz*, Heart. *h'*, Medullary plate in region of future forebrain. *h''*, Medullary plate in region of future midbrain. *hh* and *h'''*, Hindbrain. *mh*, Midbrain. *ph*, Pericardial section of body-cavity. *pz*, Lateral zone. *pr*, Primitive streak. *rf*, Medullary groove. *str*, Vertebral zone. *uw*, Protovertebræ. *vh*, Forebrain. *vo*, Vitelline vein.

forming the lobes of the brain, and notably by the two large lateral outgrowths from its front end which form the optic vesicles.

Yolk sac, or Umbilical Vesicle.

Not only does the development of the embryo commence in the embryonic area, it is also confined to it. About the ninth day the embryo begins to be marked off by a slight constriction from the rest of the blastodermic vesicle. This constriction commences first and is most marked at the anterior end of the embryo, where it receives the name of the head-fold; it is more prominent at the posterior end or tail-fold than at the sides. Its effect, well shown in Fig. 98, 2, is gradually to pinch off the embryonic portion from the rest of the blastodermic vesicle, which forms then a thin-walled sac filled with fluid, and is connected with the embryo by a stalk, which, at first short and wide (Fig. 98, 2), becomes, as the constriction deepens (Fig. 98, 4, 5), longer and narrower.

The portion of the blastodermic vesicle which is separated in this way from the embryonic portion, and takes no direct part in the formation of the embryo, is spoken of as the yolk-sac or umbilical vesicle, and the stalk connecting it with the embryo may be called the yolk-stalk.

Alimentary Canal.

From the mode of formation of this umbilical vesicle, and from an examination of Fig. 98, it is clear that there will be formed underneath the embryo a cavity closed in front and behind by the head and tail folds, but opening freely in the middle portion of its length through the yolk-stalk into the cavity of the umbilical vesicle—*i.e.*, into the cavity of the original blastodermic vesicle, of which it is really a portion. The cavity, which it is also clear from the figure is lined by the hypoblast, or lowermost of the three layers of the embryonic area, is the rudiment of the alimentary canal of the embryo. From the mode of its development it is clear that there is at first neither mouth nor anus, that the alimentary canal, indeed, has at this stage no communication whatever with the exterior. Its communication through the yolk-stalk with the cavity of the yolk-sac is at first (Fig. 98, 2) a very wide one, but as the constriction separating the embryo from the yolk-sac gets more and more marked, the yolk-stalk necessarily becomes narrower and narrower (*cf.* Fig. 98, 3, 4, 5), until ultimately its cavity becomes obliterated, and the alimentary canal becomes a completely closed tube.

The mouth and anus develop at a comparatively late period as pittings of the surface of the body, which gradually deepen until they meet at and open into the alimentary canal, which then first acquires its definite communications with the exterior. The mouth opening is formed before the anal one, which is usually not completed until very late in development. In exceptional cases it may not be formed at the time of birth, thus giving rise to congenital occlusion of the rectum.

The whole embryo now grows rapidly, and about the twelfth day acquires the shape and appearance shown in Fig. 97, the rudiments of all the important organs being by this time established. The embryo is no longer straight, but is very strongly bent on itself, the dorsal surface being convex and the ventral concave; the head end is disproportionately large, as, indeed, it is throughout the whole of development; in the neck a series of transverse ridges, the visceral arches, have appeared, and between these are slits, the visceral clefts, which lead into the alimentary canal, and so place it in communication with the exterior. Of the visceral arches the most anterior pair (Fig. 97, *m x*) lie at the sides of the mouth and form the basis of the upper jaw; the second pair (Fig. 97, *m d*) bound the mouth behind and give rise to the lower jaw; while the third pair (Fig. 97, *h y*) form ultimately part of the hyoidean apparatus.

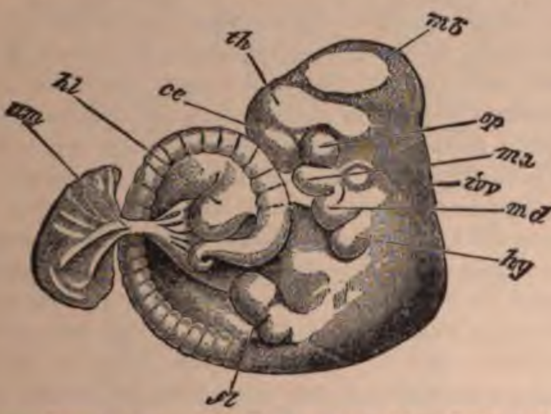

FIG. 97.—RABBIT EMBYRO OF ABOUT THE TWELFTH DAY. (From *Balfour*, after *Weldon*.) *ce*, Cerebral hemisphere. *fl*, Forelimb. *hl*, Hindlimb. *hy*, Hyoid arch. *ivv*, Fourth ventricle. *mb*, Midbrain. *mx*, Maxillary arch. *md*, Mandibular arch. *op*, Eye. *th*, Thaamencephalon. *um*, Umbilical stalk.

Rudiments of eyes (Fig. 97, *o p*) and ears are present, as are also both pairs of limbs (Fig. 97, *f l*, *h l*) in the form of simple buds, presenting as yet little or no trace of subdivision into segments.

The Embryonic Membranes.

We have now to consider certain structures which, though not forming any actual part of the embryo itself, or only doing so to a very limited extent, yet play an exceedingly important part in its development. Together with the formation of these embryonic membranes on the side of the ovum, it will be convenient to consider certain changes which occur in the uterus itself, and which are closely connected with the former.

The Decidua.

Previous to the arrival of the ovum, the lining membrane of the whole of the uterus has become much swollen and very vascular, and has undergone other changes, which will be more fully described hereafter, leading to the formation of what is called the decidua, a membrane specially developed to receive the ovum. The ovum on entering the uterus comes in contact with the decidua at some spot, and adheres to it; the decidua soon grows up around the ovum, forming at first a low wall round it, and ultimately completely enveloping it. The portion of the decidua which grows over the ovum in this way receives the name decidua reflexa; the part with which the ovum first came in contact is the decidua serotina; and the part lining the rest of the uterus, the decidua vera; this latter is of no further use, and soon disappears; it is apparently only developed because it is uncertain with what portion of the uterus the ovum will first come in contact, and consequently all parts must be ready to receive it.

The ovum embedded in the decidua reflexa at first occupies but a small portion of the cavity of the uterus, but owing to its rapid growth it soon fills the greater part, and ultimately, in woman, the whole of the uterus, the decidua reflexa coming in contact with the decidua vera.

We now return to the ovum itself. At the stage represented in Fig. 98, 1, which is slightly older than that in Fig. 94, the ovum or blastodermic vesicle is completely surrounded by the decidua reflexa, and has the following structure. The whole vesicle is invested in the zona pellucida, which gives off from its outer surface a number of little processes or villi (Fig. 98), which fit into little depressions in the decidua reflexa. The blastodermic vesicle itself presents in the embryonic area all three layers, epiblast, mesoblast, and hypoblast, and, as shown in the figure, the mesoblast has extended a little way beyond the embryonic area, so that surrounding this area is a ring in which, as in the area itself, all three layers are present. The rest of the vesicle consists of two layers, epiblast (or ectoderm of Kölliker) and hypoblast (entoderm, Kölliker), the latter having now grown so as to line the whole of the vesicle (*cf.* the earlier stage represented in Fig. 94, in which it has only extended about halfway round).

Splitting of Mesoblast.—The mesoblast (mesoderm, Kölliker) continues to spread by growth at its margin, and ultimately, like the hypoblast, extends completely round the vesicle. About the time of the first appearance of the constriction separating the embryo from the yolk-sac, the mesoblast splits into two layers. Owing to this splitting, which takes place in the marginal, though not in the axial part of the embryonic area, as well as in the part of the mesoblast outside the embryo, the portion of the blastodermic vesicle in which it occurs consists now of four instead of three layers—*i.e.*, first, the epiblast; secondly, the upper or somatic layer of the mesoblast; thirdly, the lower or splanchnic layer of the mesoblast; and, fourthly, the hypoblast.

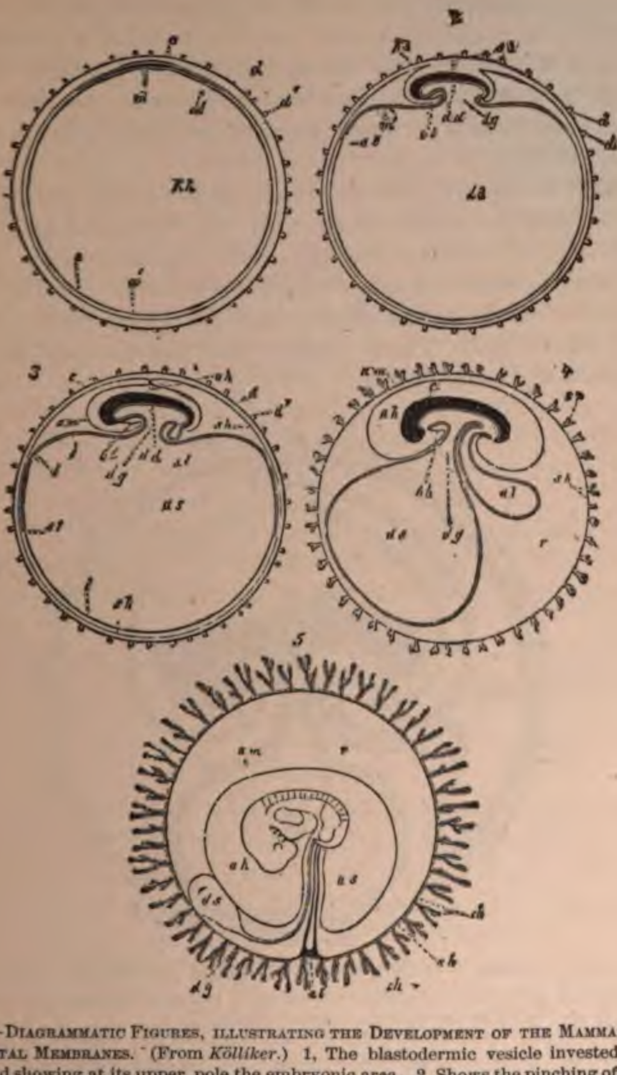

Fig. 98.—Diagrammatic Figures, illustrating the Development of the Mammalian Embryo and the Fœtal Membranes. (From *Kölliker.*) 1, The blastodermic vesicle invested in the zona pellucida, and showing at its upper pole the embryonic area. 2, Shows the pinching off the embryo from the yolk-sac, and the formation of the amnion. 3, Further development of amnion, and commencement of allantois. 4. Completion of amnion, and growth of allantois. The false amnion, or subgonal membrane, gives off villous processes. 5. The allantois has grown all round the vesicle, and gives off processes into the villi which are much larger than before. The yolk-sac is greatly reduced in size.

a. Epiblast of embryo. *a'.* Epiblast of non-embryonic part of blastodermic vesicle. *al.* Allantois. *am*, Amnion. *ch.* Chorion. *ch* 2. Chorionic villi. *d* Zona pellucida. *d'.* Processes of zona. *dd.* Embryonic hypoblast. *df.* Area vasculosa. *dg.* Yolk-stalk. *ds.* Yolk-sac. *e.* Embryo. *hh.* Pericardial cavity. *i.* Non-embryonic hypoblast. *kh.* Cavity of blastodermic vesicle. *ks.* Head-fold of amnion. *m.* Embryonic mesoblast. *n.* Non-embryonic mesoblast. *r.* Space between true and false amnion. *sh.* False amnion, or subgonal membranes. *ss.* Vail fold of amnion. *st.* Sinus terminalis. *si.* Processes of zona pellucida. *vl.* Ventral body-wall of embryo.

The upper or somatic layer of the mesoblast becomes very closely connected with the epiblast, the two together practically forming a single layer, which is spoken of as the somatopleure. Similarly the lower or splanchnic layer of the mesoblast becomes intimately connected with the hypoblast, with which it forms what is practically a single layer—the splanchnopleure.

The Body Cavity.—In the embryo itself the somatopleure forms the lateral and ventral portions of the body wall, while the splanchnopleure forms the similar portions of the wall of the alimentary canal. The space between somatopleure and splanchnopleure—*i.e.*, the actual split between the two layers of the mesoblast—becomes the pleuro-peritoneal or body-cavity of the embryo. These relations will become more evident from an inspection of Fig. 99.

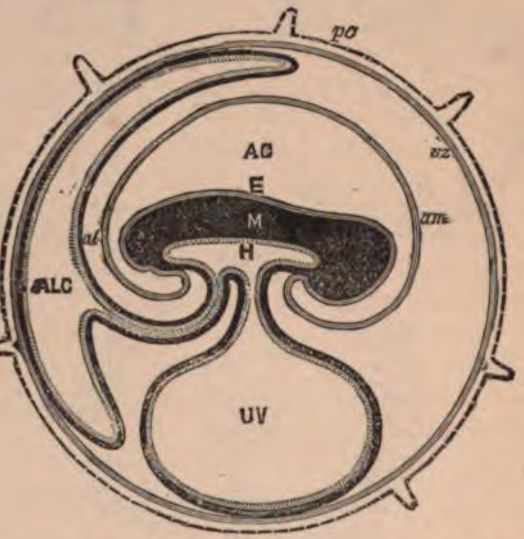

FIG. 99.—DIAGRAM OF THE FŒTAL MEMBRANES OF A MAMMAL. (From *Balfour*, after *Turner*.)

Structures which either are or have been, at an earlier period of development, continuous with one another, are presented by the same character of shading.

AC. Amnionic cavity. ALC. Allantoic cavity. *al*. Allantois. *am*. Amnion. E. Epiblast of Embryo. H. Hypoblast of embryo. M. Mesoblast of embryo. *pc*. Zona, with villi. *sz*. False amnion or subgonal membrane. UV. Yolk-sac or umbilical vesicle.

The Amnion.—Outside the embryo the somatopleure rises up so as to form a low wall surrounding the embryonic area. This wall, which receives the name of amnion, rapidly increases in height (Fig. 98, 2), and the folds forming it arch over the back of the embryo so as partially to cover it. A little later the folds meet one another along the middle line of the back, and so completely cover the embryo (Fig. 98, 3). At this period we have an inner layer of the amnion (Fig. 98, 3, *a m*) closely investing the embryo, and an outer layer (Fig. 98, 3, *s h*) lying immediately beneath the zona pellucida and continuous below with the outer wall of the yolk-sac, *d s*.

A little later still, the two layers of the amnion coalesce along their line of meeting above the back of the embryo, and the inner layer becomes completely separated from the outer layer (Fig. 99). At the same time, owing to the splitting of the mesoblast extending all round the yolk-sac, the outer layer of the amnion becomes completely separated from the yolk-sac, and now forms a thin lining membrane closely applied to the inner surface of the zona pellucida.

The condition of things at this stage is shown in Figs. 98, 4, and 99. The outer layer of the amnion, *s h* in Fig. 98, 4, and *s z* in Fig. 99, lining the zona pellucida, sometimes receives the name false amnion, but is better called the subzonal membrane; the inner layer *a m*, which forms an investment over the back of the embryo, but at some little distance from it, and which is clearly, from its mode of formation as a fold of somatopleure, continuous with the body wall of the embryo, is spoken of as the true amnion, or simply as the amnion.

It will further be evident from the figures that the space between the two layers of the amnion, *r* in Fig. 98, 4, being part of the space formed by the splitting of the mesoblast, is continuous with the body-cavity of the embryo.

It is customary to speak of the space between the inner layer of the amnion and the embryo, A C in Fig. 99, which is really not between the layers of the amnion at all, as the amnionic cavity.

THE ALLANTOIS.

During the growth of the amnion, a small hollow bud grows out from the ventral surface of the alimentary canal close to its posterior extremity. This is known as the allantois (Fig. 98, 3). As it is an outgrowth of the alimentary canal, its walls must consist, like those of the alimentary canal itself, of splanchnopleure—*i. e.*, of an outer layer formed by the splanchnic layer of the mesoblast, and an inner lining of hypoblast.

The allantois hangs down at first into the body-cavity; it grows rapidly, and soon passes out beyond the embryo into the space between the two layers of the amnion, which space we have already seen to be directly continuous with the body-cavity of the embryo (*cf.* Figs. 98, 4, and 99). Continuing its growth, it comes in contact with the subzonal membrane, and then spreads out so as to form an inner lining to this membrane, which, growing at its edge, ultimately extends round the whole or greater part of the ovum (*cf.* Figs. 98, 5, and 99).

THE CHORION.

The outer wall of the ovum now consists of three layers—viz., the zona pellucida on the outside; inside that, the subzonal membrane or false amnion; and inside that again, the allantois. These three layers, originally distinct, soon become fused completely with one another, and are spoken of collectively as the chorion.

The Vascular System of the Embryo.

Blood-vessels are developed in the embryo at a very early period. The heart appears in an embryo of about the age represented in Fig. 98, 2—*i.e.*, shortly after the commencement of the constriction separating the embryo from the yolk-sac, as a pair of tubes one on either side of the body; these soon meet one another and fuse underneath the throat to form a single tubular heart, in connection with which are vessels developed in the mesoblast both of the embryo and of the yolk-sac.

Circulation of the Yolk-sac.

The heart very soon commences beating: it drives the blood forwards through a series of aortic arches on either side, whereof one is situated in each of the visceral arches already described; from these some of the blood goes forwards to the head, but the greater part is sent back to the hinder part of the body along a couple of arteries, the dorsal aortæ, which subsequently unite together to form the single dorsal aorta of the adult. From the dorsal aortæ vitelline arteries take the blood to a network of vessels developed in the mesoblast of the yolk-sac, and from these it is returned to the posterior end of the heart by vitelline veins.

Circulation in the Allantois.—The allantois is, from its earliest appearance, very vascular, and its blood vessels increase very rapidly in size as it develops. Two very large branches from the posterior end of the dorsal aorta, the allantoic or umbilical arteries, carry blood to it from the embryo, and a couple of umbilical veins return it back again to the heart of the embryo.

Umbilical Stalk.

The amnion, which at first invests the embryo tolerably closely, later on grows rapidly so as to leave a considerable space—the amnionic cavity—between the embryo and itself. As shown in Fig. 98, 5, the amnion, as it recedes from the embryo, forms an investment to the stalk of the allantois, and it is further evident from the figure that, in addition to the allantoic stalk, the yolk-stalk will also be included in this investment. The compound stalk formed in this way, which includes both the allantoic stalk with the placental vessels and the yolk-stalk with its vessels, and is ensheathed, as stated above, by the amnion, receives the name of umbilical stalk. It serves, as shown in Figs. 98, 5, and 2, to attach the embryo to the placenta.

Bladder and Urachus.

It will be remembered that the allantois was at first a hollow bud, its cavity communicating with the alimentary canal, of which it was indeed a diverticulum (Fig. 98); the cavity soon becomes lost in the placenta itself, and if, indeed, it is ever present there it may persist in the umbilical stalk, more or less completely, throughout development; within the body of the embryo the portion of the cavity next to the alimentary canal becomes ultimately the urinary bladder, while the portion of the stalk extending from this part to the body wall of the embryo becomes the urachus.

Fate of the Germinal Layers.

It will be convenient to give here a very brief account of the ultimate fate of each of the three germinal layers of which the embryonic area consisted at a very early stage, viz., epiblast, mesoblast, and hypoblast.

In the first place, it will be noticed that out of one or other of these three layers every portion of the body of the embryo or fœtus is derived, directly or indirectly.

The epiblast, which is clearly the most superficial layer of the three, gives rise to the epidermis covering the whole of the body, and also, as we have seen, to the whole of the central nervous system, both brain and spinal cord, and indeed to the nerves themselves, inasmuch as these arise as outgrowths from the central nervous system. It also forms the lining of the mouth and anus, which as already noticed are pittings-in from the exterior; and it takes a very important share in the formation of the organs of special sense.

The hypoblast, or lowermost of the three layers, forms the epithelium lining the alimentary canal and its glands, and also that lining the bronchi and lungs, which arise as diverticula of the alimentary canal. It also forms a longitudinal solid rod—the notochord—which runs the whole length of the body underneath the central nervous system in the position afterwards held by the vertebral centre and the base of the skull.

The mesoblast forms all the rest of the body: muscles, bones, connective tissue, and blood-vessels, wherever they occur, are mesoblastic; also the peritoneal epithelium and the urinary and reproductive organs.

DEVELOPMENT OF THE HUMAN EMBRYO AND FŒTUS.

Concerning the early development of the human embryo, our knowledge is still in a very unsatisfactory condition. Of the stages passed through during the first fortnight after impregnation we know exceedingly little, and those occupying the third week are only very imperfectly known to us; but from the end of the third week onwards the various stages of development have been tolerably fully and satisfactorily described.

For reasons stated at the outset, we shall here give a brief account of such early stages as have been described, and endeavor, by the aid of the facts already set forth, to frame something approaching to a consistent account of the development of the human embryo from the ovum.

Estimation of Age of Embryos.

A preliminary difficulty, and one that cannot be satisfactorily disposed of at present, lies in the fact that, after we have obtained an embryo, we have no really trustworthy means of determining its exact age. One of the most constant accompaniments of pregnancy is cessation of menstruation; and His, one of the greatest authorities on the subject, considers that this fact affords the most trustworthy basis for estimating the age of embryos. He lays down the following rule:[1] The age of an embryo is the time that has elapsed since the first day of the first omitted period. Thus, supposing the commencement of a period to be due on January 5, and that when this time comes the period is omitted, but some time subsequently, say February 9, an embryo is aborted; then the age of that embryo would be, according to His, the interval between January 5 and February 9—*i.e.*, five weeks.

In arriving at this result His argues in the following manner: The ovum leaves the ovary either at or shortly before the menstrual period; if fertilized, presumably by spermatozoa previously introduced, menstruation does not occur; but the changes in the uterine mucous membrane, instead of, as usual, becoming retrogressive, continue to be progressive, and so prepare the uterus for the reception of the ovum. Hence the first omitted menstrual period corresponds in point of time with the fertilization of the ovum; and hence the age of the embryo may be taken as the time that has elapsed since the first omitted period.

This method of calculation is, however, open to very grave objections. We have already seen that there is much reason for thinking that the decidual membrane, which is broken up and discharged at the menstrual period, is prepared for the réception, not of the ovum which is liberated from the ovary at the time of the period, but of the ovum set free at the last preceding period. The process of fatty degeneration, associated with the break-up and discharge of the decidua, has almost certainly commenced before the occurrence of the period; and it is almost inconceivable that the mere act of fertilization at the commencement of the Fallopian tube of an ovum which, in all probability will not reach the uterus for at least a week, should be able to arrest the degenerative changes already commenced in the decidua, stop suddenly the menstrual discharge that is on the verge of taking place, and convert the retrogressive changes of the decidua into progressive ones. His's theory also does not accord with the well-established fact that, in order to insure pregnancy, the most favorable time for copulation is shortly after the period, in which case fertilization and the commencement of development of the ovum could hardly be coincident with the first omitted period.

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[1] His, Anatomie Menschlicher Embryonen. To this very important and beautifully illustrated work, which has been freely used in compiling the present chapter, the reader is referred for more detailed descriptions of the development of the human embryo than can be given here.

For these reasons the theory advocated by Pflüger and others appears preferable, according to which the decidua discharged at any period is not related to the ovum set free at that period, but to the ovum liberated at the immediately preceding period. On this view, however, we are left absolutely without means of determining the age of embryos; and although an exact determination is immaterial in the case of later embryos, yet when we are dealing with early ones it is a point of great importance.

Partly for this reason, and partly because it has hitherto been customary to calculate the age according to the system of which His is the most recent advocate, we shall in this chapter give the ages estimated in this manner—*i.e.*, by the age of an embryo will be meant the interval between the first day of the first omitted period and the time at which the embryo is discharged from the uterus. It must be repeated, however, that this method of calculation can only be justified by its general adoption, its readiness of application, and most of all by the fact that no other precise system has yet been proposed. Viewed on its own merits the method is not only imperfect, but is even opposed to many well-established facts.

The First Week.

The process of segmentation in the human ovum has not yet been seen. It is, however, in the highest degree probable that segmentation takes place during the passage of the ovum along the Fallopian tube, and that it is effected in a manner practically identical with that already described in the case of the rabbit.

Neither do we know the length of time taken by the human ovum to travel down the Fallopian tube to the uterus. According to the best authorities this passage "probably occupies not less than eight days in the human subject." In the rabbit we have seen that the uterus is reached on the third day, so that either the process of development must from the first be much slower in the human embryo than in the rabbit, or else the human ovum must enter the uterus in a far more advanced condition than happens in the case of the rabbit. Such evidence as we have points rather in favor of the former alternative.

Second Week.

Of embryos towards the close of the second week of development, a few examples have been described; but there is some doubt whether any of these few can be regarded as perfectly normal.

Reichert's Embryo.—The best known instance is an ovum described by Reichert, and estimated to be of about the thirteenth day.

This ovum, which is represented four times the natural size in Figs. 100 and 101, was found *in situ* in the uterus of a woman who had committed suicide. There was a fully formed decidua reflexa, within which was the ovum itself (Figs. 100 and 101), a vesicular body of the shape shown in the figure, measuring 0.2 inches along its greater diameter, and .12 inches from side to side. Of the two sides the one turned towards the uterus (the upper surface in Fig. 101), was more convex than the opposite side, facing the decidua reflexa. The margin of the vesicle, as shown in the figure, was thickly fringed with villi, the largest of which were .07 inches long, and slightly branched. The villi were absent both from the uterine surface and from the opposite one, leaving two bare circular patches. In the middle of the uterine patch was a smaller circular spot of a darker color, .05 inches in diameter, and indicated in the figure.

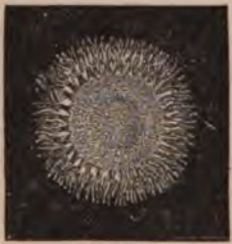


FIG. 100.

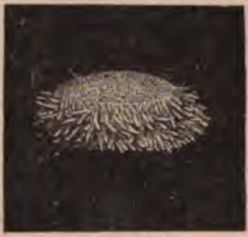


FIG. 101.

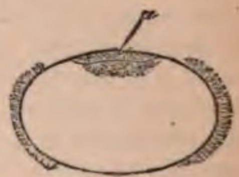


FIG. 102.

FIGS. 100, 101.—FRONT AND SIDE VIEWS OF REICHERT'S OVUM. (From *Kölliker*). × 4.

FIG. 102.—DIAGRAMMATIC SECTION OF REICHERT'S OVUM. (From *His*.) × 5. *a*. The germinal area.

Not the slightest trace of any embryonic structure was discovered; there was no indication of either primitive or medullary grooves. The wall of the vesicle is described as consisting of a single layer of epithelial cells prolonged outwards to form the villi. In the circular patch on the uterine surface, which is spoken of as the germinal area, a second inner layer of finely granular cells was present. The cavity of the vesicle was occupied by a gelatinous fluid, traversed by a network of fine fibres, and containing within it a spherical body.

Ova of somewhat similar appearance, and of apparently about the same age, have been described by Wharton Jones, Breuss, Kollmann, and others; but in none of these cases was any trace of an embryo discovered. The chief points that we learn from these other specimens are, first, that the spherical body described by Reichert is made up of nucleated cells, and is apparently solid and in connection with the germinal area; and, secondly, that it is highly probable that the wall of the vesicle really consists, not of a single layer, but of two layers, of which the inner one is of the nature of connective tissue, and therefore of mesoblastic origin.

It is not easy to make any satisfactory comparison between these ova and the stages already described as occurring in the rabbit, and the difficulty is much increased by the doubt we must feel as to whether the ova in question are perfectly normal, or are not to a greater or less extent pathological. As the different ova described appear, however, to agree in the most important points, it is advisable to make such comparisons as is possible between them and the more usual processes of mammalian development.

His considers that the stage reached by these ova is a very early one—but very little older, indeed, than that represented for the rabbit in Fig. 95; and he illustrates his views by the diagrammatic section of Reichert's ovum given above (Fig. 102.)

He considers that the outer wall of the vesicle consists of epiblast alone; that hypoblast is present only in the germinal area, where it forms the inner layer described by Reichert; and that the spherical mass of cells is also hypoblast, and will afterwards become hollowed out and expanded to form the yolk-sac.

Against this interpretation it must be pointed out (1) that the stage in question is in the rabbit a very early one, and it would follow that, except in its much greater size, the human ovum on the thirteenth day has advanced no further than the rabbit's of the third day, which, considering the usual rapidity of the early embryonic processes, would be at least very extraordinary; (2) that the evidence is very strong—indeed, practically conclusive—for thinking that the wall of the vesicle has, in addition to the epiblast layer, an inner connective-tissue lining, which is even described by some observers as vascular, and which must be of mesoblastic origin. It appears, therefore, certain that the stage reached is a considerably later one than supposed by His; and it is also clear that, if normal, it does not exactly correspond to any definite stage in the development of the rabbit.

The human ovum, indeed, would appear to be peculiar (1) in the unusually early or "precocious" development of a layer of vascular mesoblast lining the blastodermic vesicle; and (2) in the very exceptionally late appearance of definite rudiments of the embryo itself. It is extremely important that no opportunities of determining whether the latter feature is normal or pathological should be lost in future.

His's Embryo E.—The youngest human ovum containing a distinct embryo is one obtained by His in 1869, and carefully described by him, and is at present deposited in the Anatomical Museum at Basle. This embryo, which is considered by His to be of about the fourteenth day, is represented magnified twenty diameters, in Fig. 106. The whole ovum is an oval vesicle, measuring along its greater diameter .33 inches, and along its lesser .22 inches, and covered all over with branched villi. The contained embryo is .08 inches in length, and attached at its hinder end by a short thick stalk .2 inches long to the inner surface of the vesicle. The embryo is separated by a very slight constriction—most marked at its anterior end—from the yolk-sac (Fig. 106, *Y, s.*), which measures .09 by .05 inches. Covering over the embryo, but at a short distance from it, is a membranous fold A, which is clearly the true amnion. The embryo itself presents on its dorsal surface a medullary groove, bounded by two prominent medullary folds; the only other organ visible is a slightly prominent fold between the embryo and yolk-sac (Fig. 106, *H*), probably the rudiment of the heart; two vessels arising close to this were traced over the yolk-sac.

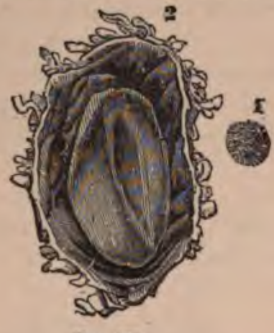


FIG. 103.

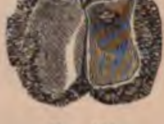


FIG. 104.

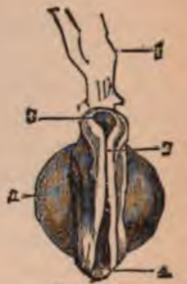


FIG. 105.

FIG. 103.—HUMAN EGG AT TWELVE TO THIRTEEN DAYS.—1, Natural size, 2, Opened and enlarged (after *Thomson*.)

FIG. 104.—HUMAN EGG AT FIFTEEN DAYS NATURAL SIZE. (after *Thomson*). [*Charpentier*.]

FIG. 105.—EMBRYO OF THE EGG IN THE PRECEDING FIGURE.—1, Umbilical vesicle. 2, Medullary burrow. 3, Cephalic portion of embryo. 4. Caudal part of embryo. *S*, Membranous appendix. (Amnion). [*Charpentier*].

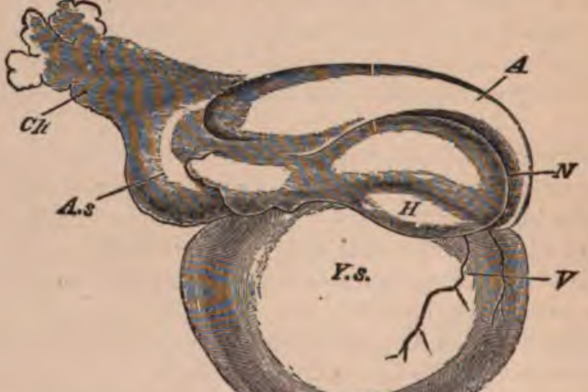


FIG. 106.—HUMAN EMBRYO OF ABOUT THE FOURTEENTH DAY, SEEN FROM THE RIGHT SIDE. (From *His*.) × 20.

A, Amnion. *A.s*, Allantoic stalk, connecting the hinder end of the embryo with *Ch*, The Chorion. *H*, Heart. *N*, Medullary or neural groove. *V*, Bloodvessel of yolk-sac. *Ys*, Yolk-sac.

Other embryos of apparently about the same age have been described by His, Allen Thomson, and others, which agree in their main features with that just noticed, and differ principally in being rather further advanced—the constriction between embryo and yolk-sac being more marked, the embryo itself being rather larger, and the medullary groove both deeper and longer.

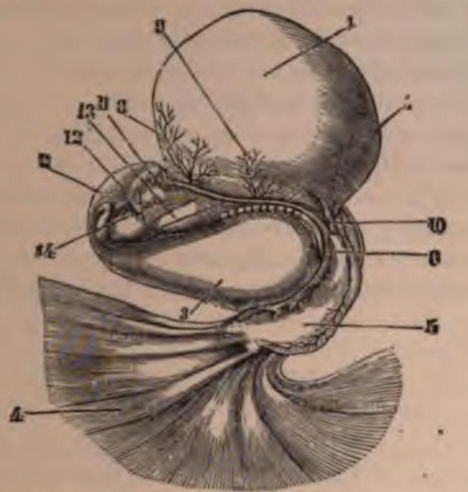


FIG. 107.—HUMAN EMBRYO FROM FIFTEEN TO EIGHTEEN DAYS.—1, Umbilical vesicle. 2, Amnion. 3, Its cavity. 4, Chorion. 5, Allantois. 6, Its pedicle. 7, Border of ventral opening. 8, Omphalo-mesenteric vein. 9. Omphalo-mesenteric artery. 10, Posterior of intestine. 11, Heart. 12, Aorta. 13, Esophagus. 14, Pharyngeal arches. (*Coste.*) [*Charpentier.*]

On comparing these embryos with the corresponding stages of the rabbit, the most marked difference is seen to lie in the fact that the human embryo is already at this very early period connected with the chorion by a stalk, while in the rabbit this connection is not acquired till considerably later. This stalk is clearly the allantois, so that the difference might be expressed by saying that the allantois develops earlier in the human embryo than in the ordinary mammal. But this is not all. Not only does the allantois develop earlier, it also develops in a totally different manner. Usually among mammals the allantois arises, as we have seen

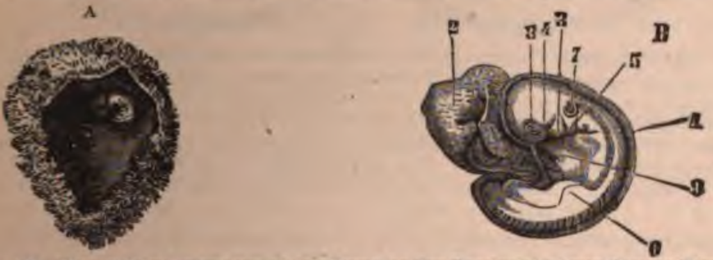


FIG. 108.—HUMAN OVUM AT THE END OF THE THIRD OR THE BEGINNING OF THE FOURTH WEEK.—*A* Egg in its natural size. *B*, Embryo enlarged.—1, Amnion. 2, Umbilical vesicle. 3, First pharyngeal arch. 4, Superior maxillary bed of this arch. 5, Second pharyngeal arch, behind which two other smaller ones are visible. 6, Anterior extremities. 7, Auditory vesicle. 8, Eye. 9, Heart, (after *Thomson.*) [*Charpentier.*]

above, as a hollow saccular outgrowth from the alimentary canal, which grows to and becomes connected with the chorion. In the human embryo, however, the allantois appears, from the researches of His, not to arise as an outgrowth from the alimentary canal at all, and, indeed, never to pass through the saccular stage shown in Figs. 100 and 101, but to be present from the very earliest period as a stalk connecting the hinder end of the embryo with the chorion.

The following series of diagrams, copied from His, will make this clear, and will show how the stage now being considered may be derived and probably is actually arrived at, from the stage represented by Reichert's ovum. The figures represent a series of diagrammatic longitudinal sections through ova at successive stages of development. Fig. 102, as we have seen, represents Reichert's ovum, with the exception that the layer of mesoblast, which is undoubtedly present as an inner lining to the wall of the vesicle, is omitted. In Fig. 109, A, the commencement of the formation of the embryo is indicated; the germinal area has become somewhat depressed, but at its anterior end, (to the right in the figure), is lifted up slightly by a constriction—the head-fold. In Fig. 109, B, this head-fold has deepened, and the head-end of the embryo is now distinctly raised above the yolk-sac, *Y, s*; at the hinder end of the embryo the germinal area, however, still preserves, as in the former figure, its primitive connection with the chorion. In Fig. 109, C, the embryo has reached the stage shown in Fig. 108; indeed, Fig. 109, C, is a diagrammatic longitudi-

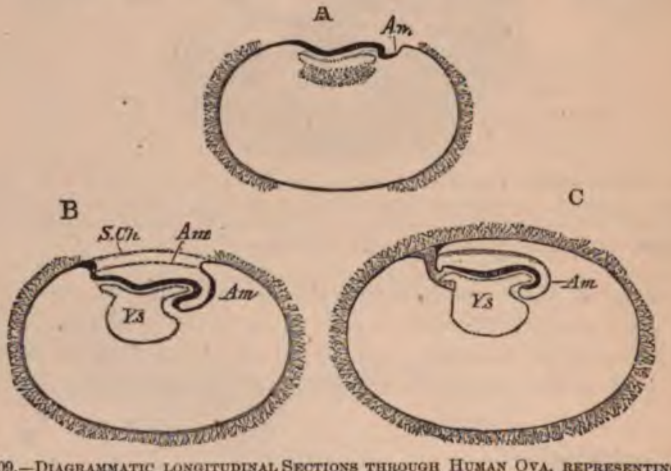


FIG. 109.—DIAGRAMMATIC LONGITUDINAL SECTIONS THROUGH HUMAN OVA, REPRESENTING STAGES (HYPOTHETICAL) INTERMEDIATE BETWEEN REICHERT' OVUM AND HIS'S EMBRYO E. (From *His.*) × 5.

A, Shows commencement of head-fold, and of amnion (*Am*). B, Rather later stage: the head-fold and amnion are more marked, as also is the yolk-sac (*Y.s.*) The hinder end of the embryo is continuous with the chorion through the allantoic stalk. The dotted lines indicate, hypothetically, the subsequent growth of the amnion. C, A still later stage: equivalent to that of His's embryo E (*vide* Fig. 105). The amnion is completed, and the villi extend completely round the ovum.

nal section through this very embryo. At the hinder end of the embryo the tail-fold has now just commenced; but this does not interfere with the stalk—the allantoic stalk—which still connects directly together the embryo and the chorion.

If this view is correct, it is clear that in the human embryo the allantois is formed unusually early, and in an altogether exceptional manner. We may clearly connect this "precocious" development of the allantois with the "precocious" appearance of the vascular layer of mesoblast lining the blastodermic vesicle in the stage represented by Reichert's ovum; and we may perhaps regard both features, in so far as they are exceptional, as examples of the tendency to abbreviation or shortening of the processes of development, which is a feature so constantly encountered by the student of embryology. The establishment of a vascular connection between the embryo and the chorion, and so indirectly with the mother, is, as we have seen, the characteristic feature of mammalian development, and, therefore, we need not wonder at finding in the most highly developed of all mammals this feature thrown back to an earlier stage than that at which it originally appeared, and hurried on prematurely, even at the expense (as it would seem) of the embryo itself, whose development is unusually retarded.

The series of figures given above indicate also the supposed stages in the development of the amnion, the sole peculiarity in which is that the head-fold—always the most prominent portion—here forms, with the side folds, the whole amnion, there being no tail-fold developed at all. After completion of the amnion, the villi, previously absent over the germinal area, extend all over the ovum. *Cf.* Fig. 109, C.

Summarizing what we know about the processes of development in the first fortnight, it would appear probable that the ovum—fertilized in the upper part of the Fallopian tube—travels slowly down towards the uterus, which it reaches about the eighth day. While in the tube it almost certainly undergoes segmentation in the usual mammalian manner, but does not increase greatly in size; according to Allen Thomson, "its diameter on arriving in the cavity of the uterus does not probably surpass one-hundredth (0.25 mm.), or at most one-eightieth of an inch." After entering the uterus it probably increases rapidly in size. It very early develops villi on its surface, and is completely enclosed in the decidua reflexa, at any rate, by the thirteenth day. In the development of the ovum the most noteworthy features appear to be the very early establishment of a lining of vascular mesoblast to the blastodermic vesicle, the very early appearance and peculiar mode of formation of the allantois, and the curiously late appearance of the embryo itself.

Krause's Embryo.—Concerning the allantois it ought to be mentioned here that a human embryo of a very much later stage than those we have just considered—*i.e.*, about the fourth week—has been described by Krause, in which there was no allantoic stalk connecting the embryo and chorion together, but the allantois hung down as a bag from the hinder end of the embryo, very much as shown in Fig. 98, 4. As this is at present an isolated exception to the general rule concerning the allantoic stalk in human embryos, it is perhaps permissible to regard it merely as an abnormality, in which case it may be viewed in the light of a reversion to the primitive mode of development of the allantois.

Third Week.

Of embryos belonging to the first half of the third week, only a very limited number have been accurately described and figured; but towards the close of the week specimens become far more abundant, and from this point onward our knowledge of the development of the human embryo is in a tolerably satisfactory condition.

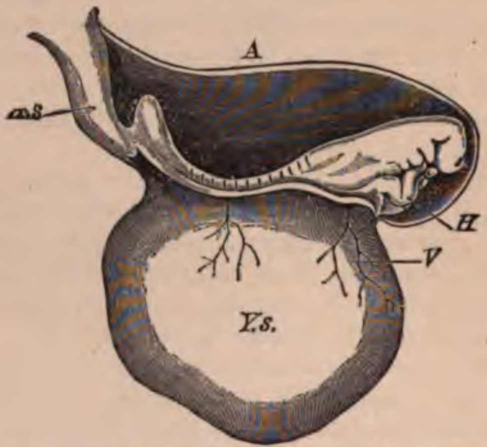


FIG. 110.—HUMAN EMBRYO OF ABOUT THE MIDDLE OF THE THIRD WEEK. (From *His*, after *Coste*). *A.* Amnion. *A.s.* Allantoic stalk. *H.* Heart. *V.* Blood-vessel of yolk-sac. *Y.s.* Yolk-sac.

Fig. 110 shows the condition of the embryo at an age between the fifteenth and eighteenth days, as described and figured by Coste. The whole ovum measures .63 inches along its greater diameter, and is covered exteriorly with short, slightly branched villi. The embryo is attached to the inner side of the chorion by the short allantoic stalk seen at the left-hand end of the figure, *A.s.* The embryo itself is .017 inches in length, and is invested—not closely, but at some little distance—by the amnion. The head end of the embryo is completely raised above the yolk-sac, but the body is still so widely connected with the yolk-sac, that one can hardly speak of a distinct yolk-stalk. The hinder end of the embryo is bent upwards rather strongly—a very characteristic feature of the early human embryo, and one which is very probably to be ascribed, at any rate in great part, to the peculiarity already noticed concerning the allantois.

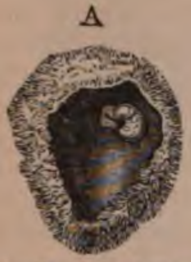
In the neck three thickenings—the visceral arches—are visible on each side, but the clefts between them have not yet been completed; below the neck, in the angle between the embryo and the yolk-sac, is the heart, a large tube twisted into an S shape. Blood-vessels are visible on the yolk-sac—which have a diameter of .1 inches—and also in the allantoic stalk, whence they pass into the chorion, the inner layer of which is vascular all round the ovum, though the blood-vessels do not as yet pass into the villi.

The middle portion of the embryo is clearly divided into protovertebræ; but there are no traces whatever of limbs, or of either eyes or ears.

End of Third Week.

By the end of the third week or commencement of the fourth the embryo has undergone important changes. Figs. 111 and 112 show the whole ovum and the embryo at this age.

The whole ovum, which is shown of the natural size in Fig. 109, is somewhat pyriform, and measures 1 inch along its greater diameter; it is covered all over with long branched villi. The embryo, which is represented on a larger scale in Fig. 112, has increased very considerably in size. It is no longer straight, but is bent very strongly on itself—so much so, indeed, that it forms more than a complete circle, the flexure of the whole embryo being quite as strongly marked as in a rabbit embryo of the twelfth day (Fig. 97).



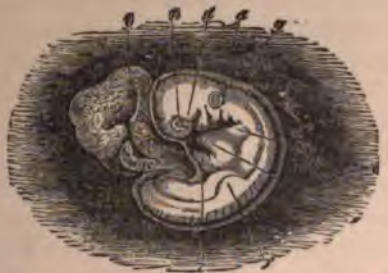


FIG. 111.—HUMAN OVUM AT ABOUT THE COMMENCEMENT OF THE FOURTH WEEK. Part of the wall of the ovum has been removed to expose the embryo. (From *Kölliker*, after *Allen Thomson*). × 1.

FIG. 112.—THE SAME EMBRYO AS IN FIG. 109, REMOVED FROM THE OVUM, AND MAGNIFIED.

a. Amnion. *b*. Yolk-sac. *c*. Mandibular arch. *d*. Maxillary arch. *e*. Hyoidean arch; behind this are the first and second branchial arches. *f*. Rudiment of forelimb. *g*. Auditory vesicle. *h*. Eye. *i*. Heart. × 5.

The yolk-sac is about the same size as before, having a diameter of .11 inches, but its surface is wrinkled, and it is now connected with the embryo by a very distinct stalk. The amnion is very closely applied to the embryo, and the allantoic stalk, as before, connects the embryo with the chorion.

In the embryo itself the most noteworthy features besides the strongly marked flexure are the following: There are indications of thirty-five protovertebræ, the greatest number ever present. Both pairs of limbs are present as short buds with very wide bases of origin, the arm and leg of either side being connected together by a low ridge, the Wolffian ridge, of which the limbs are merely special local developments. All the main divisions of the brain are present, and can be easily recognized, as can also the ganglia of several of the nerves. Five visceral arches are visible on each side—*viz.*, the maxillary (forming the upper jaw), mandibular (forming the lower jaw), hyoidean, and first and second branchial arches. The optic vesicles are present as outgrowths of the brain, but there is as yet no trace of the lens. The alimentary canal is a nearly straight tube, which communicates with the yolk-sac by only a very narrow channel.

The whole embryo measures about .15 inches along its longest diameter, but, owing to the flexure of the body, its real length must be at least double this.

Fourth Week.

By the end of the fourth week the rudiments of all the more important organs have become definitely established, and the embryo has arrived at a very well-marked period of development. It has now reached a stage corresponding closely with that attained by the rabbit embryo about the twelfth day, and by a chick embryo towards the end of the fourth day of incubation.

We have already had occasion, when considering the earliest stages of development, to notice the extreme slowness with which the human embryo develops. This is very strikingly exemplified by the facts just stated—*viz.*, that the human embryo takes four weeks to reach the same stage of development and complexity of organization, and, what is more, the same actual size, that a chick embryo accomplishes in exactly one-seventh of the time.

This is doubtless in part due to the fact that the chick embryo is exceptionally well off in having an enormous supply of food ready to hand in the shape of the yolk of the egg; while, on the other hand, the mammalian embryo has to devote part of its energies to the establishment, at as early a period as possible, of the placenta for the sake of obtaining nutriment from the mother. But although this may explain why the mammal develops more slowly than the chick, it does not in any way help us to understand why the human embryo develops during its early stages at less than half the rate of the rabbit, and we must be content for the present to accept as an unexplained fact that the human embryo does dawdle over its development in a manner yet completely inexplicable.

As the stage we are now dealing with, the end of the fourth week, is an important one in many ways, and as our knowledge of it, owing to His's admirable investigations, is in a very satisfactory and fairly complete state, it will be well to describe it in some detail.

Figs. 113, 114 and 115 are different views of an embryo of this age. Fig. 113 shows the external appearance as seen from the right side; Fig. 114 is a longitudinal section to show the alimentary canal and parts in connection with it; while Fig. 115 is a diagrammatic representation of the principal blood-vessels *in situ.*

The embryo is bent on itself as shown in the figures, and is closely invested by the amnion; it is connected with the yolk-sac by a short but narrow stalk, and with the chorion by the wide allantoic stalk, now somewhat longer than it was before.

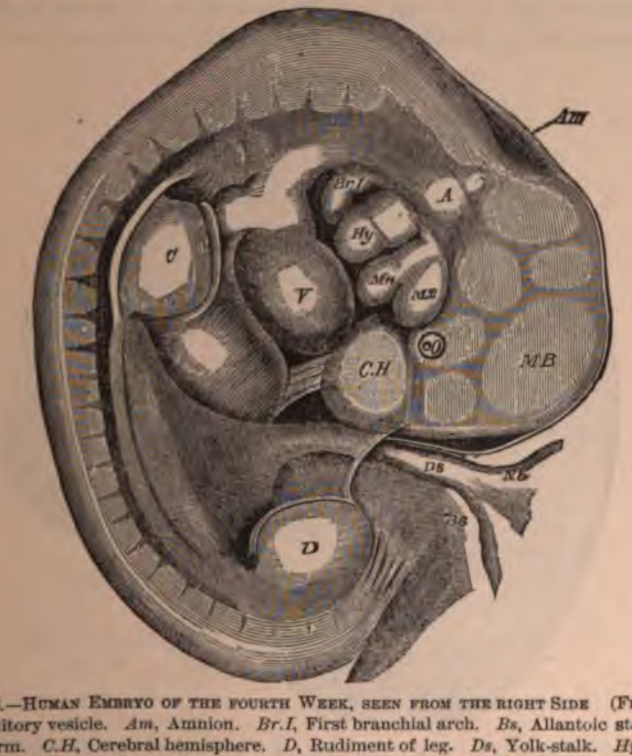


FIG. 113.—HUMAN EMBRYO OF THE FOURTH WEEK, SEEN FROM THE RIGHT SIDE (From HIS.) × 13.—*A*, Auditory vesicle. *Am*, Amnion. *Br.I*, First branchial arch. *Bs*, Allantoic stalk. *C*, Rudiment of arm. *C.H*, Cerebral hemisphere. *D*, Rudiment of leg. *Ds*, Yolk-stalk. *Hy*, Hyoidean arch. *MB*, Mid-brain. *Mn*, Mandibular arch. *Mx*, Maxillary arch. *Nb*, Yolk-sac. *O*, Eye. *V*, Ventricular portion of heart.

The body measures along its greatest diameter .27 inches, but if straightened out would be about .54 inches in length. In the head the several divisions of the brain are clearly visible, as are also the visceral arches and clefts, and the eye and ear. In the body the full number of protovertebræ, thirty-five, is present; and the limbs are still short and very broad buds, whose bases extend over several segments. Immediately underneath the neck is seen the large prominence formed by the heart, and, below this again, a lesser one due to the liver.

The alimentary canal forms a continuous and but slightly twisted tube.

The mouth, on the under surface of the head, opens into the buccal cavity, from which the pituitary diverticulum is given off towards the base of the mid-brain, while in the floor of the hinder part is the rudimentary tongue. Behind this the buccal cavity passes into the pharynx, which opens to the exterior by two visceral clefts on each side. In the floor of the pharynx is a slit-like opening, the glottis, leading into a short canal, the trachea, which bifurcates into two blind sacs, the rudiments of the lungs.

Behind the pharynx the alimentary canal is continued as a narrow tube, the œsophagus, with the lungs on either side of it. The œsophagus opens into a stomach which is but very slightly dilated, and is continued into the small intestine. This runs forward and (Fig. 114) joins the large intestine at a rather sharp angle. From this angle the cavity of the yolk-stalk, leading to the yolk-sac, arises. The large intestine is at first tubular, but after giving off the cavity of the allantois it expands to form a cloacal sac, which opens to the exterior at the anus: just before doing so it receives, on its dorsal surface, the openings of the Wolffian ducts, the ducts of the

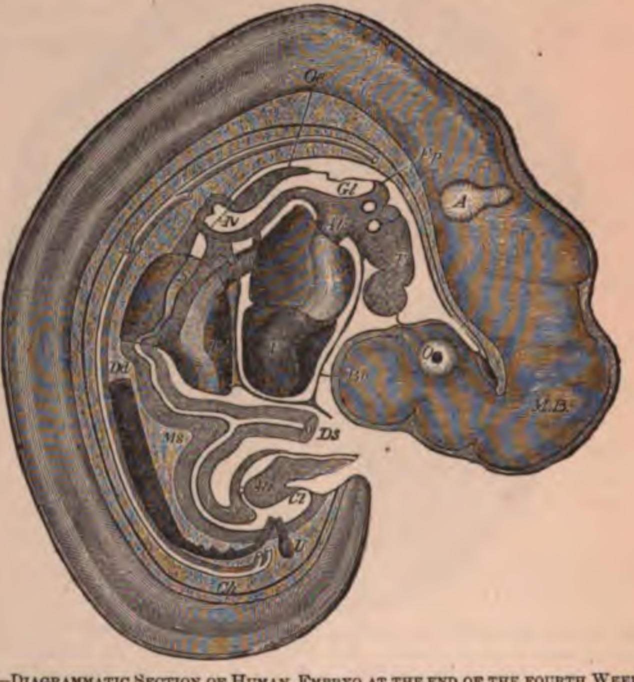
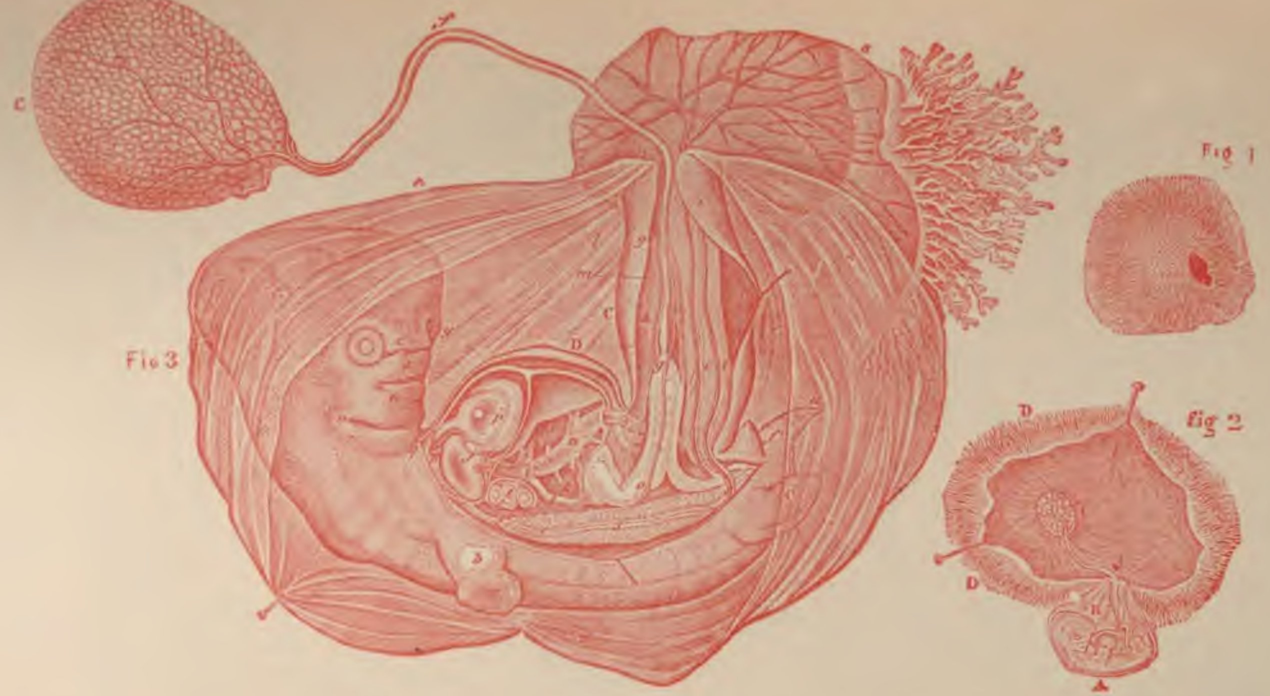


FIG. 114.—DIAGRAMMATIC SECTION OF HUMAN EMBRYO AT THE END OF THE FOURTH WEEK, SHOWING THE ALIMENTARY CANAL AND PARTS IN RELATION WITH IT. (From *His.*) × 13.

A, Auditory vesicle. *Ab*, Truncus arteriosus. *All*, Allantoic stalk. *Ao*, Aorta. *Br*, Ventral wall of thorax. *Ch*, Notochord. *Cl*, Cloaca. *Dd*, First part of small intestine, the future duodenum. *Ds*, Yolk-stalk, connecting intestine with yolk-sac. *Ep*, Epiglottis. *Gl*, Glottis. *L*, Liver. *M.B*, Mid-brain. *Ms*, Mesentery. *N*, Right lung. *O*, Eye. *Oe*, Œsophagus. *S*, Stomach. *T*, Tongue. *U*, Ureter. *V*, Ventricle.



THE OVUM AND ITS APPENDAGES AT ABOUT THE THIRTY-SIXTH DAY.

FIG. 1.—The Human Ovum, natural size, from the thirtieth to the thirty-sixth day.
FIG. 2.—The same, laid open. A, the fœtus; B, the amnion; C, the umbilical vesicle; D, the chorion.
FIG. 3.—C, the umbilical vesicle; *a*, the chorion; *b*, the upper extremity; *c*, the lower extremity; *d*, abdominal wall; *f'*, the amnion, laid open; *f*, the umbilical cord; *g*, the urachus; *h*, the omphalo-mesenteric vein; *i*, *i*, the umbilical arteries; *v*, vena cava inferior (with branches). *p*, the heart; *q*, the arch of the aorta; *s*, the Wolfian body; *t*, the lung; *u*, the lower jaw; *x*, the upper jaw; *y*, the nostril; *z*, fissure of nasal canal, extending from the nostril to the eye.

primitive kidneys. A slight dilatation near the commencement of the allantoic stalk is the rudiment of the future urinary bladder.

The liver is a large organ whose position has been already noticed; it opens by a short bile-duct into the intestine just below the stomach.

The vascular system, which is shown in Fig. 115, has attained very considerable complexity. The heart, which is of great size, lies between the head and the liver, and already exhibits all the principal divisions of the adult. It is bent on itself like a letter ∽, whereof the first or upper loop is the auricular portion of the heart; the second or lower loop, which is in very close proximity to the cerebral hemisphere, is the ventricular part; and the terminal limb of the ∽ is the aortic bulb which runs backwards (upwards in the figure) beneath the lower wall of the head. The auricular portion of the heart is very wide transversely; it is partially divided by a semilunar fold into right and left auricles, whereof the right

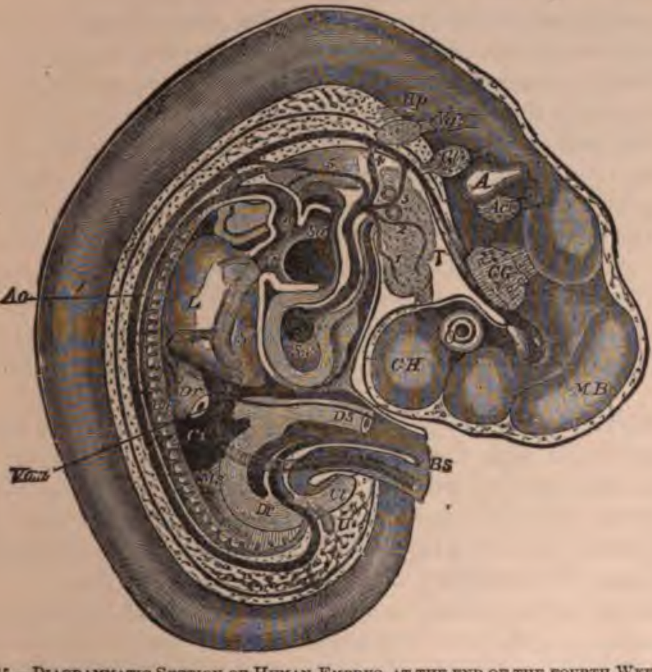


FIG. 115.—DIAGRAMMATIC SECTION OF HUMAN EMBRYO AT THE END OF THE FOURTH WEEK, SHOWING THE HEART AND BLOOD-VESSELS. (From *His.*) × 13.

A, Auditory Vesicle. *Ac*, Auditory nerve. *Ao*, Dorsal aorta. *Bs*, Allantoic stalk. *CH*, Cerebral hemisphere. *Ci*, Vena cava inferior. *Cl*, Cloaca. *Cs*, Vena cava superior. *Dr*, Small intestine. *Ds*, Yolk-stalk. *GG*, Gasserian ganglion. *Gl*, Ganglion of glossopharyngeal nerve. *Hp*, Hypoglossal nerve. *L*, Liver. *MB*, Midbrain. *Ms*, Mesentery. *O*, Eye. *Sa*, Auricular septum. *Sv*, Ventricular septum. *T*, Tongue. *U*, Ureter. *Un*, Wolffian body, or primitive kidney. *Vg*, Vagus, or pneumogastric nerve. *V.om*, Vitelline, or omphalomesenteric vein. 1, First aortic arch, forming lingual branch of external carotid artery. 2, Second aortic arch, forming external carotid artery. 3, Third aortic arch, forming internal carotid artery. 4, Fourth aortic arch, forming on left side the dorsal aorta. 5, Fifth aortic arch, forming the pulmonary artery.

auricle receives (1) venous blood brought from the body of the embryo by two large veins, the right and left *ductus cuvieri*, each of which is formed by the union of an anterior cardinal or jugular vein returning blood from the head, and a posterior cardinal vein coming from the hinder part of the body and chiefly from the Wolffian bodies or primitive kidneys; and (2) blood which is more arterial in character, brought back from the chorion by the umbilical or allantoic veins, and discharged into the right auricle by the vena cava inferior. The opening of the vena cava inferior into the right auricle is guarded by two prominent lips, the outer one of which is the Eustachian valve, which direct the blood from the inferior cava into the left auricle, which also receives the exceedingly small pulmonary veins.

The ventricular portion is partially divided into right and left ventricles by a septum incomplete above. The aortic bulb contains at present only a single tube, the cardiac aorta, into which both ventricles discharge; this runs back (up in the figure) to the hinder part of the floor of the buccal cavity, and then gives off on each side a series of aortic arches which run up in the visceral arches, forming the side walls of the pharynx, and unite together above the pharynx to form the dorsal aorta, which runs back to the hinder end of the body. Of these aortic arches there are at first five on each side. The first and second aortic arches, lying in the mandibular and hyoidean arches respectively (Figs. 113 and 115), have already lost their primitive connections with the dorsal aorta, and together form the external carotid artery, the first arch representing its lingual branch.

The third aortic arch (Fig. 115, 3) forms the internal carotid artery, but is still connected with the dorsal aorta. The fourth arch (Fig. 115, 4) forms the main portion, and later on the whole of the dorsal aorta; the arches of the two sides, right and left, are at this stage equal in size. The fifth arch (Fig. 115, 5) joins the dorsal aorta, but before doing so gives off a branch—the pulmonary artery—to the lung of its side.

The dorsal aorta, formed in this way by the third, fourth, and fifth aortic arches of each side, runs down the dorsal surface of the embryo, giving off small arteries to the alimentary canal and Wolffian bodies. About the level of the cloaca it divides into the two umbilical arteries which convey the blood of the embryo along the allantoic stalk to the chorion, whence it returns charged with nutrient matter by the umbilical veins, and so passes by the inferior vena cava to the right auricle.

The vessels in connection with the yolk-sac are still present, but are of no great importance. The vein returning blood from the yolk-sac, after receiving the veins from the alimentary canal and thereby forming the portal vein, enters the liver, and there unites with the right umbilical vein coming from the chorion.

All the vessels are at present merely tubular channels in the tissue of the embryo, lined by endothelium, but with no proper connective tissue or muscular walls of their own.

Concerning the other organs of an embryo of this age, we may notice the following points: The Wolffian bodies or primitive kidneys (Fig. 115, *Un*) extend forwards as far as the lungs. Each consists of a series of short convoluted tubes, commencing with dilated Malpighian bodies, and opening at their other ends into the Wolffian duct. The two Wolffian ducts open separately into the cloaca, nearly opposite to the opening of the allantois. Of the permanent kidneys and ureters there is no trace, unless a small saccular dilatation on each Wolffian duct close to its opening into the cloaca be the commencement of the ureter (Fig. 115, *U*).

The large size of the head, due almost entirely to the brain, is a striking feature in nearly all vertebrate embryos of this age, though less marked in mammals than in some of the lower forms. In the human embryo the brain at this stage forms about one-third the total length of the embryo. Besides all the main divisions of the brain, the Gasserian ganglion on the fifth nerve, and the ganglionic swellings in the auditory, glossopharyngeal, and pneumogastric nerves are very evident (Fig. 115).

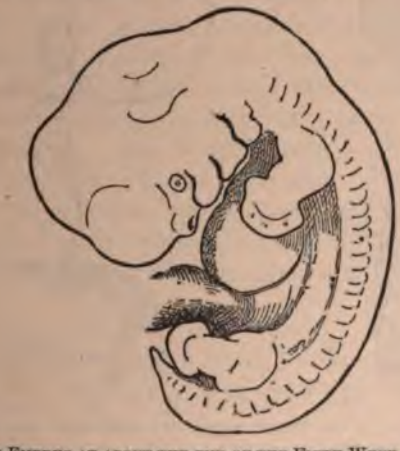


FIG. 116.—HUMAN EMBRYO AT ABOUT THE END OF THE FIFTH WEEK. (From *His.*) × 5.

The olfactory organs are present as shallow pits on the under surface of the head, communicating by grooves—the rudiments of the posterior nares—with the mouth. The eyes are of very small size as compared with other vertebrate embryos, and the lens is still in the form of an open pit. The auditory organs (Figs. 113 and 115) are closed pear-shaped vesicles, situated just above the tops of the hyomandibular clefts—the rudiments of the future tympano-Eustachian passages—but having as yet no connection with them; rudiments of the aqueductus vestibuli, semicircular canals, and cochlea are present as slight outgrowths from each vesicle.

Finally, we may direct attention to the presence of a very rudimentary diaphragm between the heart and liver, and to the short, stumpy tail, in which the number of vertebræ is never greater than that present in the coccyx of the adult.

Fifth Week.

The rudiments of all the more important organs being already definitely established, there will be no occasion to describe the later embryos in detail; but it will suffice to state the leading features of each of the well-marked periods of development, and to give brief accounts of the formation of some of the more important organs up to the time of birth.

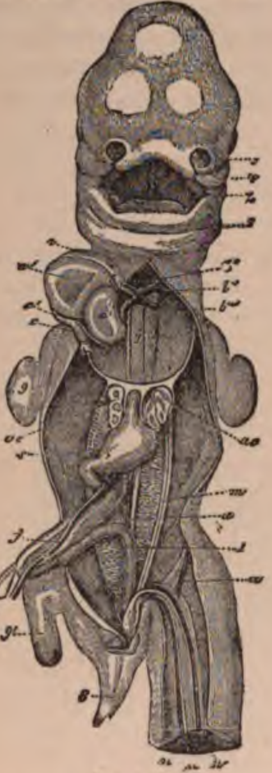


FIG. 117.

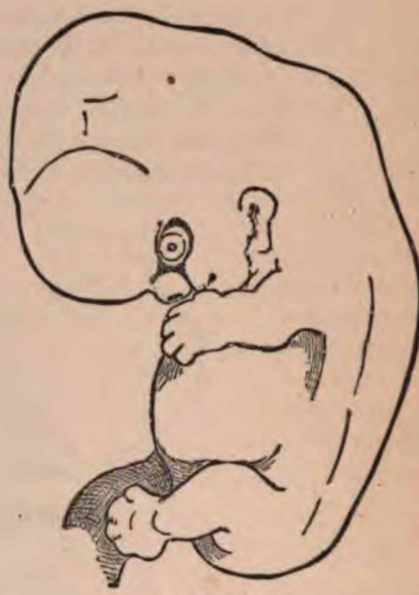


FIG. 118.

FIG. 117.—HUMAN EMBRYO OF THE THIRTY-FIFTH DAY, SEEN FROM THE VENTRAL SURFACE, AND PARTIALLY DISSECTED. (From *Köliker*, after *Coste*.) × 5.

3, Left external nasal process. 4, Maxillary arch. 5, Mandibular arch. 8, Tail. 9, Arm. 9', Leg. *a*, Right vitelline artery. *ae*, Lungs. *b*, Aortid bulb. *b'*, First persistent aortic arch, the carotid arch. *b''*, Second persistent aortic arch, the systemic arch. *b'''*, Third, or pulmonary arch. *c*, Right vena cava superior. *c'*, Venous sinus of heart. *e*, Stomach. *i*, Rectum. *j*, Left vitelline vein. *m*, Wolffian body. *n*, Umbilical or allantoic artery. *o'*, Left auricle. *s*, Portal vein. *u*, Umbilical vein. *v*, Right ventricle. *v'*, Left ventricle. *x*, Yolk-stalk. *z*, Tongue.

FIG. 118.—FŒTUS OF ABOUT THE SIXTH WEEK. (From *His.*) × 5.

At the end of the fifth week the embryo measures about .39 inches in length, and weighs about 15 grains. Its external appearance is shown in Fig. 116, and the leading features of its anatomy in Fig. 117.

In this latter figure the embryo is represented from the ventral side, and is partially dissected, the liver being completely removed. The chief features in which it differs from the embryo of the fourth week are the following: The whole body is not nearly so strongly flexed, but has begun to straighten out. The limbs are considerably larger, and already show signs of division into their several segments. The gill clefts, with the exception of the hyomandibular cleft, have completely closed up, and the face is more fully formed than before. The yolk-sac is small, and is connected with the embryo by a long slender stalk. The allantoic stalk is still short and thick. The amnion, instead of closely investing the embryo, is now at some distance from it, and is very nearly in contact with the chorion. The villi of the chorion are very large and branched, and still extend over the whole surface of the ovum, though they are rather larger opposite the spot where the ovum is directly attached to the uterus—*i.e.*, the decidua serotina, the site of the future placenta—than they are elsewhere.

Of the internal organs of the embryo, the stomach is now a more conspicuous dilatation than before; while the small intestine has elongated so as to form a loop, from the apex of which the slender yolk-stalk still arises; lower down, at the junction of small and large intestines, a rudiment of the cæcum has appeared. The lungs, liver, and heart have all increased in size, while the right umbilical vein, which has been all along the smaller of the two veins returning blood from the allantois to the embryo, has disappeared. The Wolffian bodies are rather shorter than before, and along their inner borders two slight thickenings of the peritoneal epithelium—the genital ridges—have appeared. There are also present two new ducts, the Müllerian ducts, which will become in the female child the oviducts or Fallopian tubes, and the uterus and vagina.

Sixth Week.

The embryo nas grown considerably, and is now from .6 to .8 inches in length. It is shown in situ in Fig. 119; while Fig. 120 is a profile view on a larger scale.

Fig. 119 shows us that the amnion is now a considerable distance from the embryo, and has indeed nearly reached the chorion; that the allantoic stalk is still short and thick; that the yolk-stalk is long and slender, its proximal portion being bound up with the allantoic stalk in the sheath formed round both by the amnion (*cf.* Fig. 98, 5), while its distal portion, ending in the small yolk-sac, lies betweenthe amnion and chorion (*cf.* Figs. 98 and 124). The limbs are larger, and show at their extremities rudiments of the fingers and toes. The mouth is still very wide; a slight prominence above it marks the commencement of the nose, and the margin of the hyomandibular cleft forms a slightly projecting ring, the external ear.

Of the internal organs, the alimentary canal has increased in length, and the cæcum is now very evident; the Wolffian bodies are somewhat smaller than before, while the genital organs have increased in size, and the permanent kidneys and ureters have become definitely established. Finally, by the end of the sixth or commencement of the seventh week, ossification commences in the clavicle, and very shortly afterwards in the lower jaw.

Second Month.

At the end of the second month the embryo measures from 1.1 to 1.6 inches in length, and weighs 180 to 300 grains. The head is very large, and forms at least a third of the whole embryo. The nose is rather more prominent, but is still very small; slight folds of skin round the mouth and eyes mark the commencement of the lips and eyelids. The external ear is definitely established, and in it helix and antihelix, tragus, and antitragus, can already be recognized. The limbs project some little distance from the trunk; the bend of the elbow being directed backwards, and that of the knee forwards. The ventral wall of the abdomen is completely formed; and the umbilical cord, which usually measures about .39

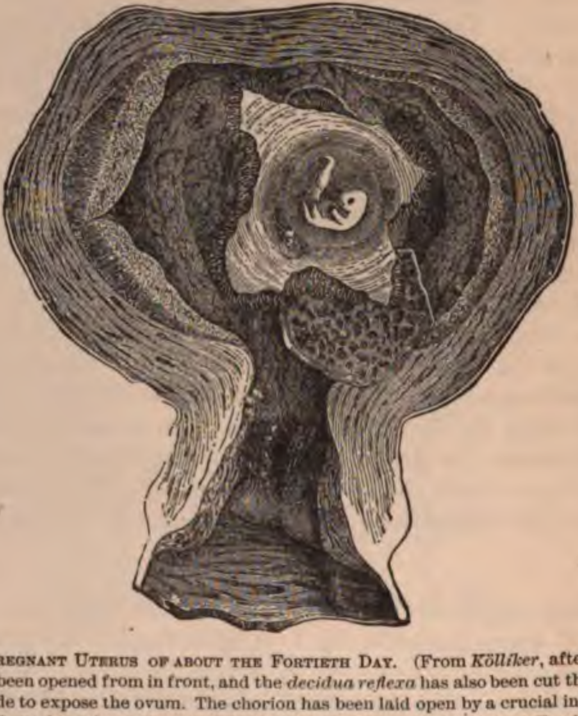


FIG. 119.—PREGNANT UTERUS OF ABOUT THE FORTIETH DAY. (From *Kölliker*, after *Coste*.) × ½. The uterus has been opened from in front, and the *decidua reflexa* has also been cut through and the flaps turned aside to expose the ovum. The chorion has been laid open by a crucial incision, and the flaps turned aside to show the embryo invested by the amnion, and with the small yolk-sac lying between the amnion and chorion. At the upper part of the figure the apertures of the Fallopian tubes are seen.

inches in length, is as a rule straight, but may be slightly twisted on itself. The anus is marked by a dark point, and the rudiments of the external organs of generation are visible; ossification has commenced in the frontal bones and in the ribs and in many of the bones of the limbs. The epidermis can now be distinguished from the dermis.

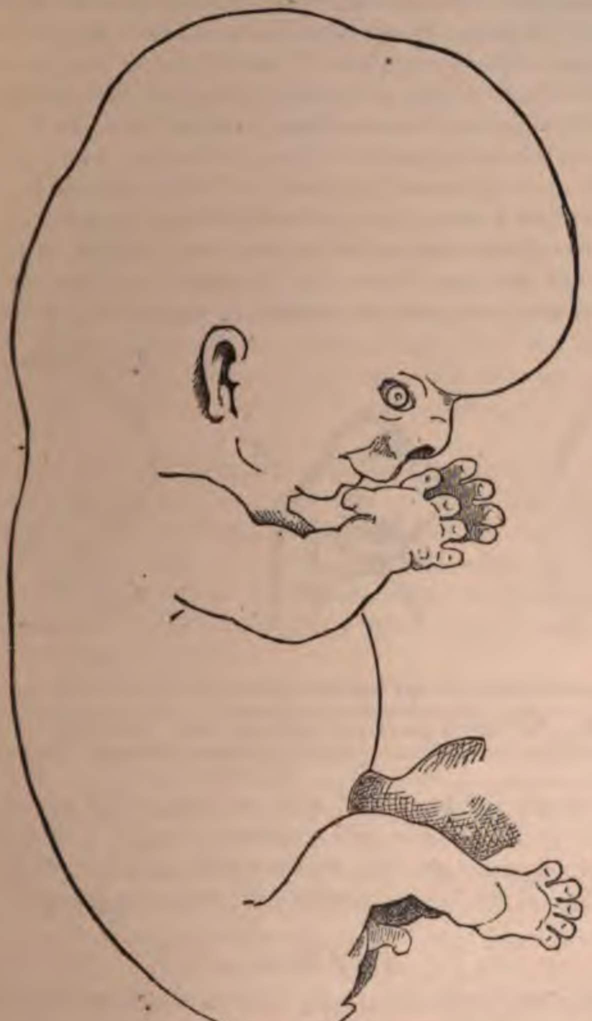


FIG. 120.—HUMAN EMBRYO AT THE END OF THE SECOND MONTH. (From *His.*) × 5.

Tenth Week.

The embryo has now a length of 1.5 to 2 inches, and weighs 675 to 720 grains. The limbs are still short, but their several divisions are far more evident than before, and rudiments of the nails have commenced to appear as small tubercles.

The ventral wall of the body is far more completely formed than heretofore. The umbilical stalk, formed, it will be remembered, of allantoic stalk and yolk-stalk bound together and ensheathed by the amnion, has grown considerably: it is now longer than the embryo, and is twisted on itself in a spiral manner. It still contains at its base a loop of intestine.

The face has developed considerably, and all the features are now definitely established; the eyelids are present; there is a distinct though very flat nose, definite lips, and well-developed external ears. In Fig. 121 the leading stages in the development of the face are shown. At the sixth week, B, the mouth opening is still very wide; it is bounded in front by the median fronto-nasal process, at the sides by the maxillary arches, and behind by the mandibular arches, which meet one another in the middle line at the site of the future chin. By the eighth or ninth week, C, the maxillary processes have grown in towards one another so as to reduce the width of the mouth, and have fused with the fronto-nasal process to complete the upper jaw. The nose is an outgrowth from the fronto-nasal process; folds of integument give rise to the eyelids and lips, while another fold, arising behind the hyomandibular cleft, forms the external ear.

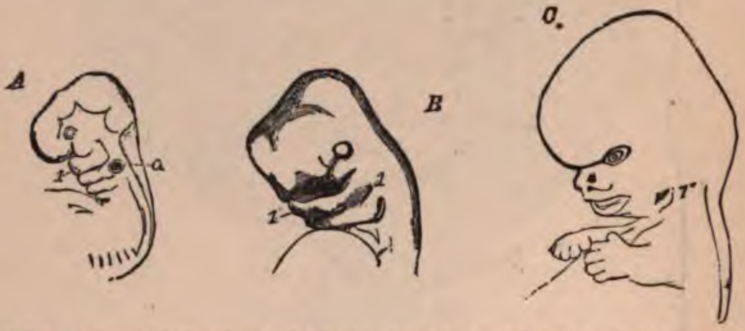


FIG. 121.—FIGURES ILLUSTRATING THE FORMATION OF THE FACE IN THE HUMAN EMBRYO. (From *Quain's Anatomy.*)—*A*, Head of an embryo of about four weeks. (After *Allen Thomson.*) 1. Mandibular arch. *a*. Ear. *B.*—Head of an embryo of about six weeks. (After *Ecker.*) 1, Mandibular arch. 1', Hyomandibular cleft. *C.*—Head of an embryo of about nine weeks. (After *Ecker.*)

Third Month.

At the end of the third month the embryo, which from this time is commonly spoken of as the fœtus, is from 5 to 5½ inches in length, and weighs 1500 to 1875 grains. The head is still very large relatively to the rest of the body, but not nearly so much so as in the earlier stages. Both mouth and eyes are closed. The neck, already present at the eighth or ninth week, is now far more evident, and the limbs, though still small, have acquired their definite shapes and proportions; the nails are present as very thin plates. The integument is slightly firmer than before, but is still very thin, transparent, and rose-colored. Hitherto, part of the alimentary canal has been situated in the allantoic stalk, and therefore outside the embryo (Fig. 114), but by the end of the third month this is withdrawn, and the whole alimentary canal, which has increased greatly in length, is thenceforward situated entirely within the abdominal cavity.

Nervous System.—The cerebral hemispheres are large, but do not yet cover the mid-brain, which latter is smooth and presents no trace of its subsequently acquired division into the corpora quadrigemina. The cerebellum is a broad transverse band; the fourth ventricle is a large cavity with a very thin roof; and the spinal cord presents well-marked brachial and lumbar enlargements.

Urino-genital Organs.—By the end of the third month very important changes have been effected in the mutual relations of the rectum, bladder, and urinary and genital ducts—changes which result in the establishment of the external generative organs and in the external differentiation of the sexes. Though these changes commenced at an earlier period than that with which we are now dealing, it has been convenient to postpone their description until we were in a position to deal with them in their entirety.

The condition of the parts with which we are concerned about the end of the fourth week is shown in Figs. 114 and 115. The terminal portion of the intestine is dilated to form the cloaca, *Cl.* Into the cloaca open—(1) on the ventral surface, the cavity of the allantois, *All*, which later on becomes the bladder; (2) on the dorsal surface, nearly opposite the aperture of the bladder, the two Wolffian ducts, coming from the Wolffian bodies or primitive kidneys.

By the end of the fifth week the following changes have occurred: (1) the essential organs of reproduction have appeared as a pair of longitudinal ridges lying along the inner sides of the Wolffian bodies (Fig. 117); (2) a pair of new ducts, the Müllerian ducts, have appeared, which open in front into the body-cavity, and unite together posteriorly to open into the neck of the bladder just before it opens into the cloaca; and (3) the Wolffian ducts have shifted so as to open into the neck of the bladder with the Müllerian ducts, and so only indirectly into the cloaca.

During the sixth week the permanent kidneys and ureters appear. The exact mode of their development in man is not known, but it is probable from analogy that the ureters are formed as outgrowths from the dorsal surface of the Wolffian ducts, in which case it is very possible that the saccular outgrowths seen in this position at the end of the fourth week (*vide* Fig. 115, *U*) are their first rudiments. The kidneys are probably formed from two masses of tissue immediately behind the Wolffian bodies and directly continuous with them. The ureters very early acquire independent openings into the bladder rather higher up than the openings of the Wolffian and Müllerian ducts. From this period up to the ninth week the changes are comparatively unimportant.

By the ninth week the essential reproductive organs have increased greatly in size, while the neck of the bladder has elongated considerably to form a sinus urino-genitalis. The two ureters open directly into the bladder, and the Wolffian and Müllerian ducts into the sinus urino-genitalis some distance below the ureters. Owing to the development of a median septum, the sinus urino-genitalis and the rectum are almost completely separated from one another; they still, however, open to the exterior by a common cloacal orifice, though the cloaca itself is now a very shallow chamber.

Immediately in front of the cloacal aperture is a small conical prominence, which, inasmuch as it becomes in the female the clitoris and in the male the penis, we may speak of as clitoro-penis (Fig. 122); on its posterior surface is a groove continued into the urino-genital sinus; and on either side of it are prominent folds of skin, *h l*, which we may call labio-scrotal folds.

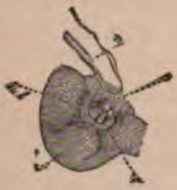


FIG. 122.

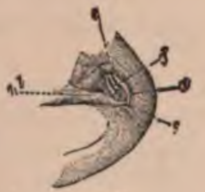


FIG. 123.

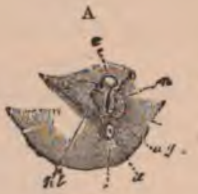


FIG. 124.

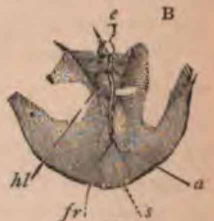


FIG. 125.

FIG. 122.—EXTERNAL GENITALIA OF A HUMAN EMBRYO OF ABOUT THE NINTH WEEK. (From *Kölliker*, after *Ecker*) × 2. *e*, Clitoro-penis. *f*, Groove continuous with urino-genital sinus. *hl*, Labio-scrotal folds. *n*, Umbilical cord. *s*, Coccygeal region.

FIG. 123.—EXTERNAL GENITALIA OF A HUMAN EMBRYO OF ABOUT THE TENTH WEEK. (From *Kölliker*, after *Ecker*.) × 2. *a*, Anus. *e*, Clitoro-penis. *f*, Urino-genital aperture. *hl*, Labio-scrotal folds. *s*, Coccygeal region.

FIGS. 124 and 125, EXTERNAL GENITALIA OF A HUMAN EMBRYO TOWARDS THE END OF THE THIRD MONTH. (From *Kölliker*, after *Ecker*.)

A.—(*Female*.) *a*, Anus. *e*, Clitoris. *f*, Urino-genital aperture. *hl*, Labia majora. *n*, Labia minora, or lips of urino-genital aperture. *s*, Coccygeal region.

B.—(*Male*.) *a*, Anus. *e*, Penis. *f*, *r*, Lips of the genital cleft fused together. *hl*, Scrotum, *s*, Coccyx.

A very little later, in the course of the tenth week, the septum between the urino-genital sinus and the rectum grows downwards so as to reach the surface. We now have no longer a cloaca, but two perfectly distinct apertures (Fig. 123, *a* and *e*), whereof the anterior is the urino-genital and the posterior the anus.

Up to this time the changes are the same in all embryos, but about the end of the tenth week external sexual differences become apparent. In female embryos (Fig. 124) the conical eminence remains small, and becomes the clitoris; the folds of skin surrounding it become the mons veneris in front and the labia majora at the sides, while the smaller folds, bounding the urino-genital orifice, become the labia minora or nymphæ; the urino-genital canal shortens considerably, so as to bring the aperture of the urethra very close to the surface.

In male embryos (Fig. 125) the conical eminence elongates and becomes the penis, the groove on its posterior surface closing to form the canal of the penis or penial urethra; the folds of skin similarly unite together in the middle line behind the penis and so form the scrotum.

The above changes are usually effected, and the organs mentioned definitely established, by the end of the third month, but the processes may be delayed till later.

Concerning the essential organs of reproduction and their ducts there is yet something to be said. The ovary and testis are at first absolutely indistinguishable from one another, and it is not until about the eighth week that characteristic differences appear between them. In both sexes there is a very close relation between the essential reproductive organs and the Wolffian bodies, which latter, as was noticed in the chapter on the ovary, send off outgrowths from their Malpighian bodies, forming the so-called "tubuliferous tissue," which lies very close beneath the germinal epithelium.

In the female the "tubuliferous tissue" gradually gets separated by connective tissue from the germinal epithelium; the Wolffian body shrinks considerably, and becomes converted into the parovarium, or epiophoron, called also the organ of Rosenmüller. The Wolffian duct is usually only recognizable in its upper portion, where it forms part of the parovarium; in ruminants, and sometimes in woman, its middle and lower portions persist as the duct of Gaertner, running in the broad ligament to the uterus. The Müllerian ducts become in their upper portions the Fallopian tubes, and in their lower portions unite to form the uterus and vagina. The fusion of the two ducts proceeds from below upwards, and, if it fail to extend as high as usual, may give rise to a double uterus, or even double vagina as well.

In the male the "tubuliferous tissue" becomes directly continuous with the seminal canals of the testis, forming by so doing the efferent canals for the passage of the spermatozoa to the exterior, the Wolffian body and duct becoming converted into the epididymis and vas deferens respectively.

The Müllerian ducts in the male are of no physiological importance; their lower united portions form the vesicula prostatica or uterus masculinus; the middle portions usually disappear, and the upper parts may either disappear or else persist in the neighborhood of the epididymis, and give rise to the "hydatids of Morgagni."

The Lungs.—The lungs make their first appearance as a hollow median diverticulum of the ventral wall of the œsophagus, just behind the gill clefts; the diverticulum consisting of an outer thicker wall of mesoblast, and an inner thinner lining of hypoblast, continuous with that of the alimentary canal.

The diverticulum very soon gives off two lateral outgrowths from its blind end, and so becomes bifid. Its condition at the end of the fourth week is well shown in Fig. 114. Later on, the mesoblast thickens considerably, and becomes riddled by a number of tubular outgrowths of the hypoblastic lining. These outgrowths become ultimately the bronchi, while their blind ends dilate to form the air-cells, which lie at first close to the surface and so give it a granular or tubercular appearance.

The original opening of the diverticulum into the œsophagus becomes modified to form the glottis, while the median portion of the diverticulum lengthens and becomes the trachea.

Fourth Month.

At the end of the fourth month the fœtus measures from 6 to 7 inches in length, and weighs from 3450 to 3900 grains. The skin is of a rosy color, and is much firmer than before. Short whitish hairs appear on the head, and a slight down on other parts of the body. The eyes, nostrils, and mouth are all closed. The chin, which has hitherto been very inconspicuous, begins to become prominent. The legs and arms are of about equal length. The external sexual characters are usually well marked. The anus is open, and the duodenum contains meconium of a light grayish-white color. The umbilicus, or point of origin of the umbilical cord, is low down, close to the pubes. In the skull the bones are still far from meeting one another, so that the sutures and fontanelles are very wide. The muscles are more fully developed, and may give rise to distinct movements of the fœtus. In abortions at this period the fœtus may live for some hours.

Fifth Month.

Length of body, 8 to 10 inches; weight, 3750 to 4500 grains. From this time onwards, according to Casper, the length of the fœtus affords a ready and easily remembered means of determining roughly its age; for from the fifth month to the end of pregnancy the length of the body in inches is approximately double the number of lunar months the fœtus has lived. Thus, at the fifth month the length is 10 inches, at the sixth month 12 inches, and so on. The weight is subject to far greater variations than the length, and consequently affords a far less trustworthy criterion of age.

The skin is more consistent than before, and presents on its surface at certain places small patches of sebaceous matter. Hairs are more extensively developed, but are still devoid of any distinct color. The legs are now longer than the arms, and the nails are well formed. The umbilicus is further forward than at the preceding month, and is now some distance above the pubes.

The head is still very large in proportion to the other parts. The heart, liver, and kidneys are also disproportionately large. The small intestine contains meconium, which is now, owing to the secretion of bile, of a pale greenish-yellow color. The gall-bladder is distinct.

Ossification has commenced in the pubes and in the os calcis.

Sixth Month.

The average length, according to Casper's calculation, is 12 inches. The weight is much more variable; its average amount is stated by Cazeaux to be $1\frac{1}{10}$ pounds.

The skin is of a dirty reddish color and much wrinkled. It is covered, at any rate in the axillæ and groins, with a sebaceous deposit. The hairs are more strongly developed and of a darker color than before. Both eyelashes and eyebrows have commenced to appear.

A complete pupillary membrane is commonly said to be present; but there seems to be some doubt on this point, and according to Velpeau and Cazeaux a large pupillary aperture is already present in the iris. Indeed, Velpeau contends that no pupillary membrane is ever present in the human embryo.

The umbilicus is still further forward than before. The meconium is much darker and more viscous than before. The testes of the male have not yet descended into the scrotum, but are found within the abdominal cavity, lying on the psoas muscles and immediately below the kidneys.

The sternum is well developed and has commenced to ossify. The nails reach to the ends of the fingers, and extend about a quarter of the way round them.

Seventh Month.

At the end of the seventh month the fœtus has a length of from 12 to 14 inches, and weighs, on an average, about $2\frac{1}{2}$ pounds.

The skin is still of a dirty reddish color, but is not so dark as it has hitherto been. There is an increased deposit of fat in the cellular tissue, causing the body to appear more plump and round. The hairs are plentiful and about a quarter of an inch in length.

The several bones forming the roof of the skull become strongly convex, the central portion of each, whence ossification starts, forming a very evident prominence. The eyelids, which have been closed since reaching their full size in the fourth month, now open.

The whole of the large intestine is filled with a dark olive-green viscous meconium. The liver is still very large relatively to the whole body, and is of a deep brownish-red color

The testes have, as a rule, descended as far as the inguinal ring, and may even have entered the inguinal canal.

The end of the seventh month is of interest as being perhaps the earliest period at which the fœtus can be born with any reasonable chance of surviving.

Eighth Month.

During the eighth month the increase in bulk is far more marked than that in length. At the end of the month the fœtus measures from 15 to 17 inches in length, and weighs as much as 4⅖ to 5½ pounds.

The skin is of a brighter flesh color than before, and is covered all over with the sebaceous deposit known as "vernix caseosa." This substance, which usually makes its first appearance about the middle of gestation, was formerly considered to be a deposit formed from the liquor amnii, but appears rather to consist of matter formed by the cutaneous glands of the fœtus, mixed with dead epithelium cells. It varies much in quantity in different cases, and is always more abundant in certain situations, notably the head, axillæ, and groins.

The chin is now far more prominent than before, the lower jaw equaling the upper in length. The pupillary membranes, if ever present, are at any rate absent now. One of the testes, usually the left one, has passed through the inguinal canal into the scrotum, while the other one is still in the canal as a rule. There is no ossification in the lower epiphysis of the femur.

Ninth Month.

At the full time the fœtus is 19 to 23 inches long, and weighs on the average 6⅗ to 7 pounds.

The skin is paler than before. The cellular tissue is filled with fat, giving roundness and firmness to the body and limbs. The hair is thick, long, fairly abundant as a rule on the head, while the down has begun to disappear from the body.

The umbilicus, formerly supposed to mark the exact middle of the body at full term, is stated by Cazeaux, on the authority of Moreau and Ollivier, to be on the average as much as .8 inches below the middle point.

Both testes are as a rule in the scrotum, which has now a corrugated surface.

Ossification has commenced in the centre of the cartilage at the lower end of the femur. This is the first epiphyseal ossification to appear in the body, and is the only one present at the end of the ninth month. Its presence appears to be very constant at this period, and it has therefore received much attention as a ready and apparently reliable test of a fœtus having reached its full time.

The Fœtal Membranes.

The youngest stage in the development of the human ovum that has yet been found in the uterus is, as we have seen, that described by Reichert, and figured on page 174. This ovum, estimated to be thirteen days old, was already completely invested in a decidua reflexa. Its outer wall was described by Reichert as consisting of a single layer of epithelial cells, a description accepted also by His; but we have seen above that there is hardly any doubt that the wall is not of so simple a structure, but that immediately under the epithelial layer there is an inner vascular layer. As the vessels in this layer can be traced at a rather later stage into continuity with the umbilical vessels of the fœtus, there is little room for doubt that this inner vascular layer is really the allantois, developed very early relatively to the other organs, and in a very unusual manner.

The Chorion.

Such being the case, we may speak of the outer wall of Reichert's ovum as a chorion. A typical chorion, as we have seen, consists of three originally separate and distinct membranes fused together to form a single one—(1) on the outside the vitelline membrane, or zona pellucida; (2) within this the subzonal membrane, or false amnion; (3) within this again, the allantois. In the chorion of the early human ovum the zona pellucida does not appear to be recognizable; the epithelial layer may possibly be in part the equivalent of the subzonal membrane; while the inner vascular layer is almost certainly the allantois.

Reichert's ovum is surrounded by a broad marginal zone of villi, the centres of the two flattened surfaces forming bare patches. A short time later, towards the end of the third week, the villi extend so as completely to surround the ovum; they consist at first merely of epithelial cells derived from the outer layer of the chorion; but in the course of the fourth week, according to Coste, outgrowths from the vascular layer of the chorion enter the villi, each of which now consists of an external epithelial covering and a central connective-tissue vascular core, the vessels of which are continuous with the umbilical vessels of the embryo.

From the fourth week up to the end of the second month, the chorion grows rapidly; the villi also increase very greatly, both in number and in size; they give off numerous branches which embed themselves in the decidua and end in free thread-like or frequently clavate processes, the so-called "roots." As in their first appearance, so also during the later stages of their growth, the epithelial layer is always in advance of the connective-tissue core, the villi presenting lateral processes or knobs caused by local thickenings of the epithelium, into which, later on, the vascular tissue penetrates.

In the course of the third month, those villi which are in connection with the decidua reflexa begin to shrink, the blood-vessels of the part of the chorion from which they spring undergoing at the same time a gradual diminution in size. The villi that are embedded in the decidua serotina, on the other hand, increase greatly in size and complexity, and ultimately form, as we shall see, the fœtal part of the placenta (*cf.* the diagrammatic figure 126).

In this way we get a distinction established between the *chorion fron-*

dosum, opposite the decidua serotina, which is very vascular, and beset with closely placed and richly branched villi; and the *chorion læve* opposite the decidua reflexa, which is a thin transparent membrane with no blood-vessels, and connected with the reflexa by scattered, slightly branched, inconspicuous villi.

Up to the end of the third month, the villi can be readily withdrawn from the crypts of the decidua in which they are lodged, and the fœtal and maternal structures separated from one another; but after the placenta is once established, the connection between fœtal and maternal elements becomes so intimate that complete separation is no longer practicable.

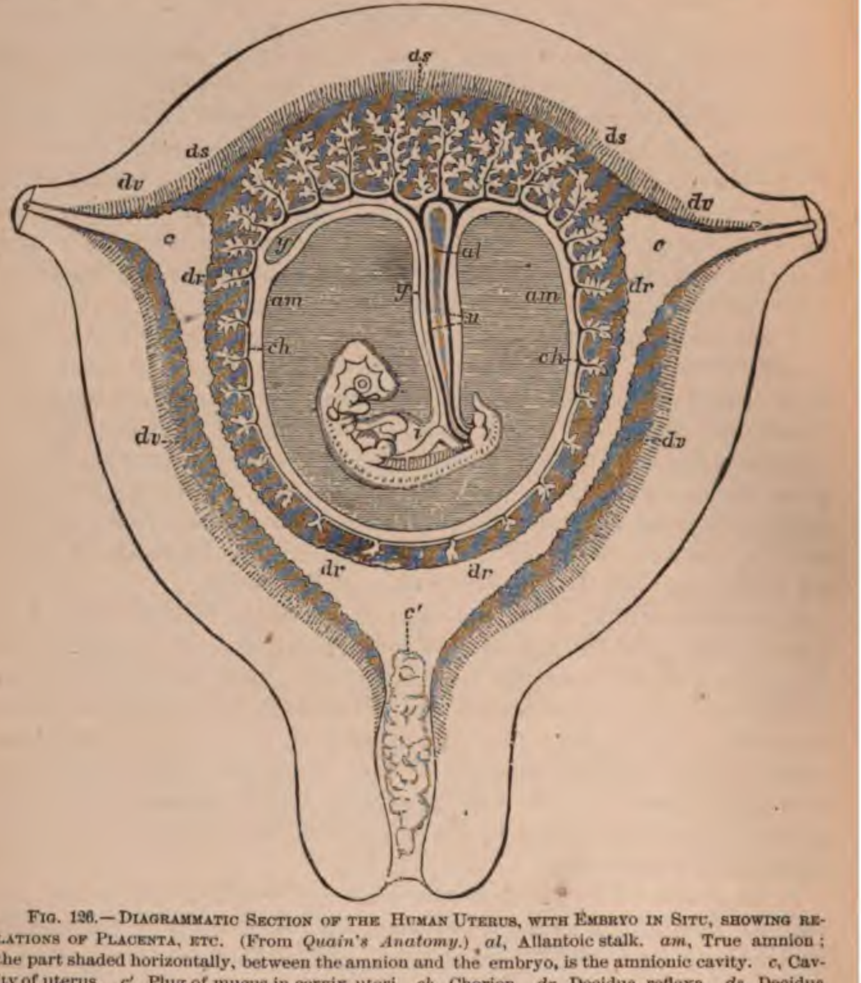


FIG. 126.—DIAGRAMMATIC SECTION OF THE HUMAN UTERUS, WITH EMBRYO IN SITU, SHOWING RELATIONS OF PLACENTA, ETC. (From *Quain's Anatomy.*) *al*, Allantoic stalk. *am*, True amnion; the part shaded horizontally, between the amnion and the embryo, is the amnionic cavity. *c*, Cavity of uterus. *c'*, Plug of mucus in cervix uteri. *ch*, Chorion, *dr*, Decidua reflexa. *ds*, Decidua serotina. *dv*, Decidua vera. *i*, Intestine of embryo. *u*, Umbilical or allantoic arteries. *y*, Yolk-sac. *y'*, Yolk-stalk.

The Amnion.

The amnion, like the allantois, appears to develop in the human species in a somewhat aberrant manner, though it is very possible that further investigations will remove many of the apparent anomalies in its mode of origin. What is known of its early stages has already been explained in the preceding chapter.

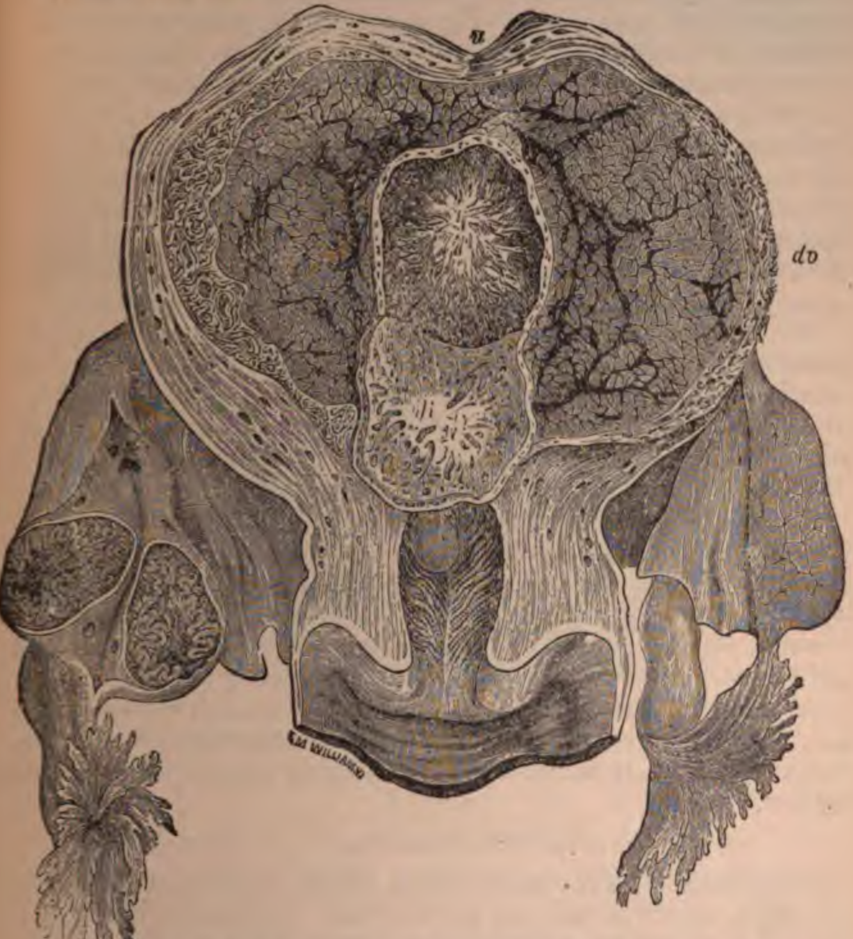


FIG. 127.—PREGNANT UTERUS OF ABOUT THE TWENTY-FIFTH DAY, CUT OPEN LONGITUDINALLY. (From *Quain's Anatomy*, after *Coste*.) Shows the *decidua vera* (*dv*) lining the uterus, and the *decidua reflexa* (*dr*) forming a capsule round the ovum (*o*); the *decidua reflexa* has been cut open and the flap turned down so as to show the crypt-like depressions of its inner surface, into which the villi of the ovum are received. The figure also shows the ovaries and Fallopian tubes. The right ovary has been cut open to display the *corpus luteum*.

The true amnion, with which alone we are now concerned, completely covers the dorsal surface of the embryo as early as the fourteenth day (*cf.* Fig. 105). Its condition at the middle of the third week is shown in Fig. 107, where it is seen to be some distance away from the embryo. At the end of the fourth week, as at the corresponding stage of the rabbit or chick, the amnion (Figs. 111 and 112) invests the embryo very closely indeed.

During the second month the amnion grows rapidly, so as to leave a large space (the amnionic cavity) between itself and the embryo, a space occupied by the liquor amnii. The amnion, by its further growth, forms a sheath to the umbilical cord, and comes in very close contact with the chorion, from which it is usually separated by a small quantity of fluid, or else by a gelatinous membrana intermedia.

Liquor Amnii.—The liquor amnii, which occupies the space between the amnion and the embryo, varies much in quantity at different periods of gestation. It is apparently most abundant about the fifth or sixth month. Its actual quantity varies also so much in different cases that it is difficult to fix its normal amount. When in excess—*i.e.*, more than about 1¼ quarts—it constitutes the affection known as hydrops amnii.

The liquor amnii contains urea, especially during the later months of gestation. It was formerly regarded as a nutritive fluid, but the researches of Gusserow point strongly in favor of its being really excretory. Gusserow considers that in the early stages of development it is simply a transudation from the fœtal vessels, but that later on it receives directly the urine discharged by the fœtus.

The yolk-sac persists throughout the whole period of gestation in the fourth and fifth months. It is a roundish, white body about .39 inches in diameter, lying between the amnion and the chorion, and usually close to the edge of the placenta (*cf.* Fig. 126). It is connected by a long, slender stalk with the umbilicus of the fœtus, the stalk being—together with the allantoic stalk—invested by the sheath formed by the amnion.

At the end of gestation the yolk-sac is still present in the same situation close to the edge of the placenta; it is rather smaller than before, measuring about .19 inches and very commonly adheres closely to the amnion.[1]

THE PLACENTA.

The placenta is a soft, vascular organ, varying in size and shape, and ranging in color from a bright to a dark red. Its function is to form a band of communication between the fœtus and the mother.

The ovum, at first free within the uterine cavity, soon becomes fixed to the mucous membrane of the uterus, the villosities that spring from the vitelline membrane forming the first chorion.

This primitive chorion, however, is soon replaced by a second chorion formed from the external layer of the blastoderm. As soon as the allantois comes in contact with this second definite chorion, the umbilical vessels which it carries penetrate the villi of the chorion. These villosities are rooted deep in the uterine mucous membrane, and establish an intimate connection between the mother and the fœtus.

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[1] [End of extract from Barnes's System.—Ed.]

While, however, those villosities that are in contact with the old or reflected decidua atrophy, those, on the contrary, that are in contact with the utero-placental mucous membrane branch and grow very rapidly. The mucous membrane itself begins to develop, and its blood-vessels become profoundly modified; so that the villi of the chorion and the utero-placental mucous membrane together form a vascular plexus, which is the placenta.

Thus the placenta is both a maternal and a fœtal organ, and we may speak of a fœtal and of a maternal placenta.

By about the fourth month, the atrophy of the villi in contact with the decidua is complete, and the placenta is definitely formed. At birth the fœtal placenta, together with the superficial layer of the utero-placental mucous membrane is expelled.

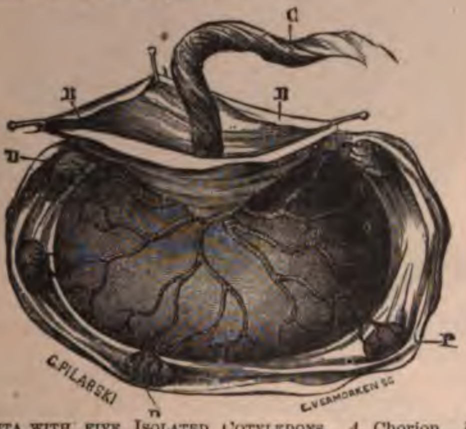


FIG. 128.—PLACENTA WITH FIVE ISOLATED COTYLEDONS. *A*, Chorion. *B*, Amnion. *C*, Cord, *D*, Isolated cotyledons.

I. *Shape.*

Although usually oval, the placenta is sometimes round, or even kidney-shaped. It is thickest at the centre, save in cases of so-called membranous placenta, when it is flattened, and of equal thickness throughout. Usually it forms a simple mass, though it may be bi-lobed, or even tri-lobed. In exceptional cases there are found, besides the ordinary placental mass, several completely detached cotyledons, united to the central body only by the vessels. These are the placentæ succenturiæ. (Fig. 128.)

The average placenta is $6\frac{1}{4}$ to $7\frac{1}{2}$ inches long, $5\frac{1}{4}$ to $6\frac{3}{4}$ inches broad, $\frac{2}{5}$ to $1\frac{1}{5}$ inches thick at the centre, and 2 to $2\frac{1}{4}$ inches thick at the edges. Its weight is very variable, and may be on an average between 16 and 19 ounces. Thus, in the first table given by Bustamante, and containing

107 cases, the mean weight was 7530 grains, while in his second table of 92 cases the mean weight was 8016 grains. The smallest placenta he observed weighed 5025 grains, and the largest 20100 grains. In a general way the weight of the placenta varies with the weight of the child.

These figures refer only to the placenta of simple pregnancies; those of twin or triplet births will be considered later.

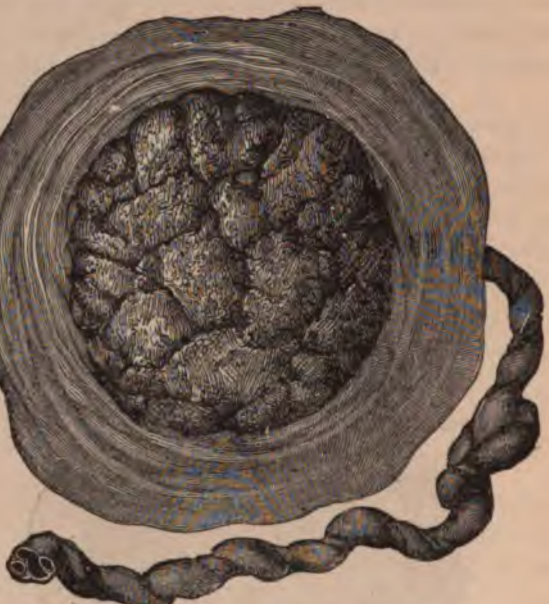


FIG 129.—PLACENTA. (EXTERNAL OR UTERINE FACE.)

Although usually implanted at the fundus, the placenta may attach itself to any point of the uterine cavity. When it is attached to the inferior segment of the organ it forms what is known as placenta prævia.

The internal or fœtal face of the placenta is smooth and moderately convex. It is covered by the chorion and the amnion, which form its most superficial layer. Here we see the implantation of the cord, the umbilical vessels, and, according to Bustamante, a number of little white bodies, the vascular corpuscles. (Fig. 130.)

The external or uterine face of the placenta is red, spongy, irregular and bleeding; it is divided by furrows into lobes or cotyledons. A layer of greyish glutinous matter covers the lobes and fills up the furrows.

The circumference is continuous with the chorion and the decidua, up to the point where the great coronary or circular sinus occurs.

II. *Structure.*

Our knowledge of the structure of the placenta is due to the researches of Hening, Jassinsky, Friedländer, Langhaus, Winkler and Leopold. Two parts are to be distinguished, the one fœtal and the other maternal.

1. *The Fœtal Placenta* (Fig. 131).—The fœtal placenta is essentially composed of the chorionic villi, and the umbilical vessels that ramify in them. A close examination of the organ will show us that each cotyledon is a tuft composed of the ultimate ramifications of the chorional villi. Each villus ends in a cul-de-sac, and most of them are provided with vessels. Some few, however, according to Langhaus, are not vascularized, and are so solidly implanted in the maternal tissue that they cannot be detached without tearing the uterine wall. Winkler states that the architectural framework of the placenta is furnished chiefly by the maternal portion of the organ, and that the villi of the fœtal placenta penetrate its meshes. Weber, Sharpey and Jassinsky claim that the villosities penetrate the uterine glands. Ercolani has even gone so far as to describe a special glandular organ of new formation in the utero-placental decidua, into which the villosities plunge, but his description is rejected by all other authorities.

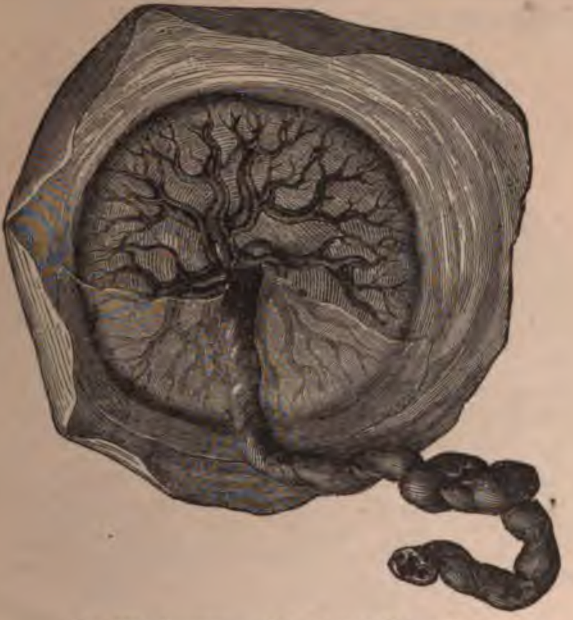


FIG. 130.—PLACENTA. (INTERNAL OR FŒTAL FACE.)

Structure of the Villosities (Figs. 132, 133).—The villosities themselves are composed of a layer of epithelium, of vessels, and of a mucoid connective tissue. They are simply prolongations of the superficial chorional stroma, with its numerous connective tissue cells, and abounding vascular net-work, which lifts up over itself a layer of epithelium. This latter is cylindrical, and is continuous over the villi and the spaces between them. Branches of the chorional vessels penetrate the villi and break up into plexuses which are known as vascular tufts. This vascular net-work lies immediately under the epithelium. This is the disposition of the vessels in ruminants, according to Dastre; but in the human species it is different. Each villosity has an afferent artery, and an efferent vein, which run side by side to the extremity of the villus, and anastomose there by means of a series of branches (Robin), or by means of a little vascular net-work (Schroeder Van der Kolk). The vessels form the axis of the villus; and below the epithelium is a very delicate membrane supposed by Dastre to be the homogeneous membrane which Goodsir and Schroeder Van der Kolk described in the human placenta, and the existence of which is denied by Schenk.

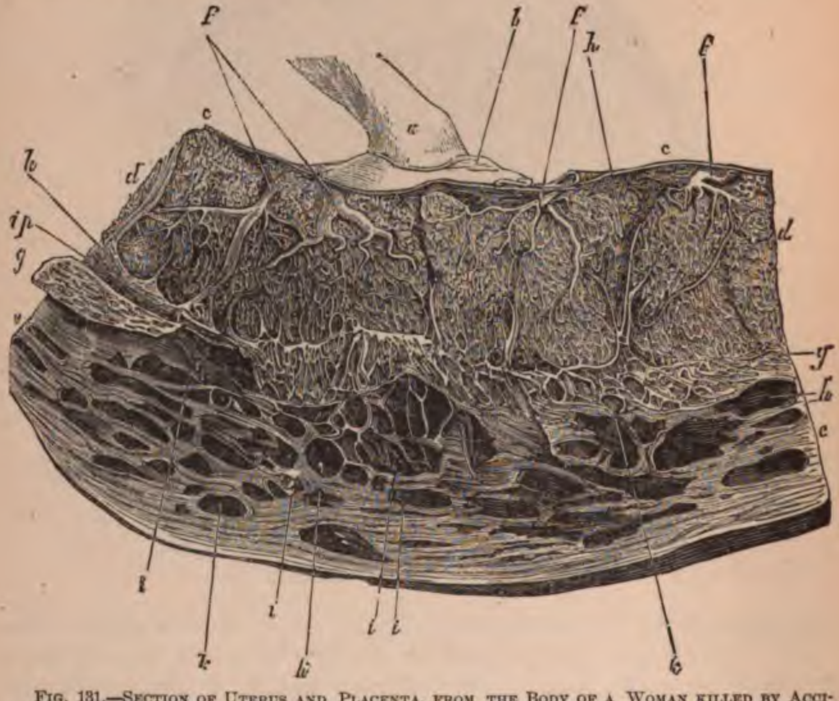


FIG. 131.—SECTION OF UTERUS AND PLACENTA, FROM THE BODY OF A WOMAN KILLED BY ACCIDENT IN THE THIRTIETH WEEK OF PREGNANCY.—*a*, Umbilical cord. *b*, Amnion. c, Chorion. *dd*, Fœtal part of placenta. *ee*, Uterine wall. *ff*, Arborescent ramifications forming the tissue of the placenta. *gg*, Decidua (maternal portion of placenta.) *hh*, Prolongation of the deciduous membrane penetrating the fœtal placenta. *ii*, Spiral or cork screw uterine arteries. *i.p*, Arterial branch penetrating the placenta. *kk*, Uterine sinus. (*A. Ecker.*)

Each cotyledon has an infundibuliform depression at its base; the allantoic layer passes like a bridge from border to border of this cavity, and thus closes the enlarged orifice. The chorion seems as if depressed and pushed back by the development of the axillary vessels at the time when the villosities were formed. Thus the interval between the two membranes is transformed into a sort of cavity irregularly partitioned by infiltrated mucoid tissue. Thus the fœtal placenta is formed from the foldings of a membrane analogous to the ordinary mucous membranes, such as that of the intestine. (Dastre.)

2. *Uterine Placenta.*—The study of the uterine placenta is inseparable from that of the utero-placental mucous membrane. Winkler divides the maternal portion of the organ into three parts, a para-uterine part, or *basal platte*, a sub-chorional part, *schluss platte*, and an intermediate part, *pars cavernosa*. (See Fig. 134.)

Leopold has followed month by month the changes that occur in the mucous membrane and in the placenta.

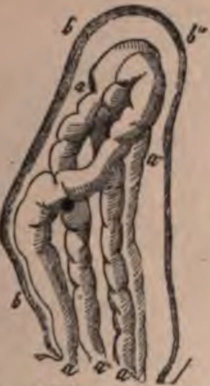


FIG. 132.—EXTREMITY OF A PLACENTAL VILLUS, ENLARGED TWO HUNDRED DIAMETERS.—*aa*, Vessels filled with blood. *a'a'*, Empty vessels. *bb*, Edges of villus. (*E. H. Weber.*)

At the end of the fourth month, the fœtal placenta forms a compact mass with a prominent border, between which and the decidua vera there is a furrow running all around the organ, out of which the decidua reflexa, the chorion and the amnion spring up to cover the placental vault. At the placental edge the mucous membrane is .12 inches thick, and closely resembles the uterine mucous membrane. It is divided into a spongy and a compact layer. In the spongy portion are several layers of wide glandular spaces, the outer ones of which still possess a cylindrical epithelium, but the inner ones are mere empty spaces or contain only epithelial *débris*. The meshes of the net-work sustain the vessels which penetrate the thick vascular trunks of the muscular coat. In the compact layer, on the other hand, sections of small and of medium-sized vessels may be seen at one and the same time. As the glandular spaces become larger and more irregular, we find here and there a border of cuboidal epithelium. In consequence of the pressure and the development of the placenta, the glands are heaped up in the serotina; they become longer and more slender. Finally the glands become separated from the placenta by an edge about .039 of an inch thick, which forms the compact layer. It is composed of greatly enlarged vessels, and of layers of nucleated decidual cells. If we follow the border of this layer, we notice projections from it at distances of .18 to .39 inches, with smaller protuberances between. The first correspond to the partitions of the pla-

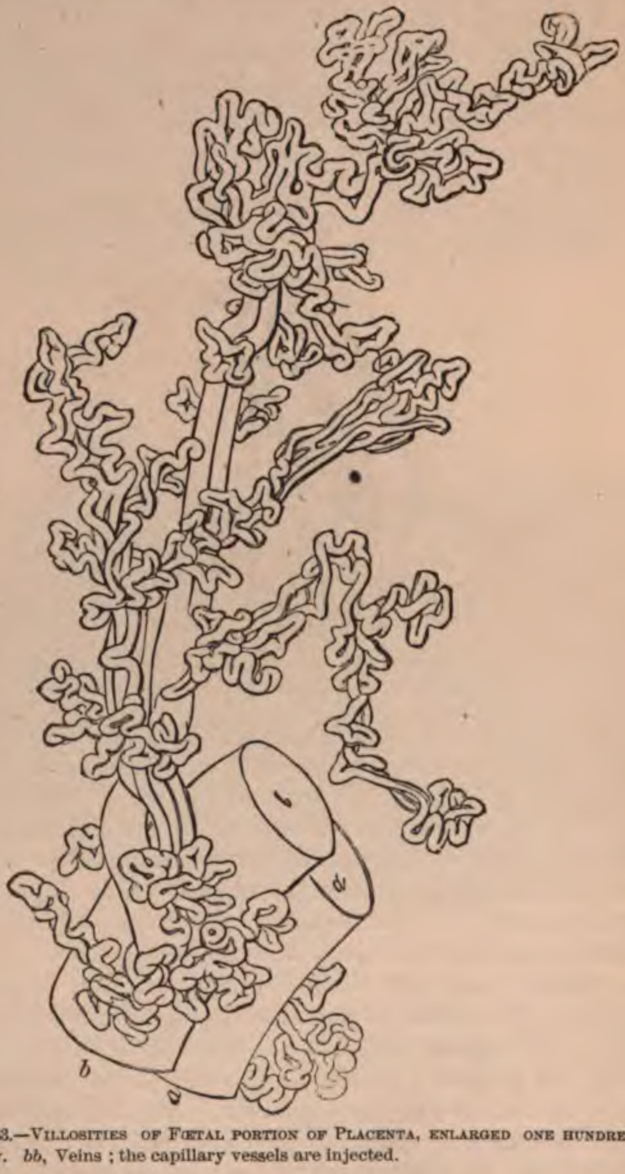


FIG. 133.—VILLOSITIES OF FŒTAL PORTION OF PLACENTA, ENLARGED ONE HUNDRED DIAMETERS. *aa*, Artery. *bb*, Veins ; the capillary vessels are injected.

cental cotyledons, and the others form the little depressions at their level. The maternal placenta is thus formed of this compact layer, which contains only a few glandular spaces; after childbirth it is expelled with the placenta. This layer, therefore, must be separated from the spongy layer by the thickness of the glandular layer, and consequently this last layer must remain attached to the surface of the placenta, together with the *débris* of the torn glands. This is the layer that we call the maternal placenta, and which is intimately united to the villosities. (See Fig. 135.)

According to Langhaus, the tissue of the decidua spreads and grows all over the tops of the villi, which are plunged deep into the maternal placenta, between its cells and dilated capillaries, but without reaching the glands. In young placentas the villi can be drawn out from their seats of implantation in the maternal organ; the epithelial layer of the villosities remaining visible upon the maternal placenta, like the finger of a glove. Langhaus distinguishes two kinds of villi, in one of which the branches are plunged into pools of blood, while in the other the principal trunk penetrates the maternal placenta, and is fixed in it by a club-shaped end.

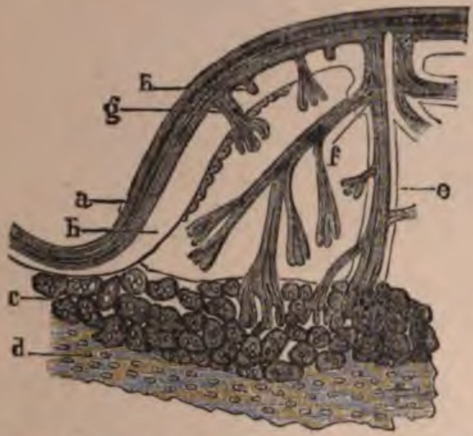


FIG. 134.—SCHEME OF THE PLACENTA. (*Winkler.*)—*a*, Placental chorion, protective layer of Hyrtl. *f*, Villous trunks with their ramifications; they are only prolongations of *a*. *g*, Short villous trunks which terminate in superficial cavities (sinus.) *h*, Obliterated villosities, not penetrating into the sinus. *b*, Closing layer with endothelium. *e*, Perpendicular placental pillars. *c*, Layer of large cells. *d*, Layer of small cells. These two layers form the foundation layer.

Between all these villi, large and small, there lie at this period capillaries and blood-spaces. Part of the villi are solidly wedged into the maternal placenta, and part of them penetrate into largely dilated capillaries which are transformed into cavernous sinuses and are situated in the superficial layer of the mucosa. Some are fixed in the maternal tissues while others float freely in blood-spaces.

Are the maternal blood-spaces provided with epithelium? Although Turner affirms it, Leopold disproves the existence of such a layer. We must, therefore, consider the blood-spaces as a system of lacunæ, communicating with one another, and stretching from the chorional to the maternal placenta; while the inter-cotyledonal spaces are the conduits of the great labyrinth which is filled with the maternal blood.

The arteries of the serotina bring the maternal blood to the blood-spaces. Reduced gradually to their endothelial intima, they open directly as capillary vessels into the blood lacunæ.

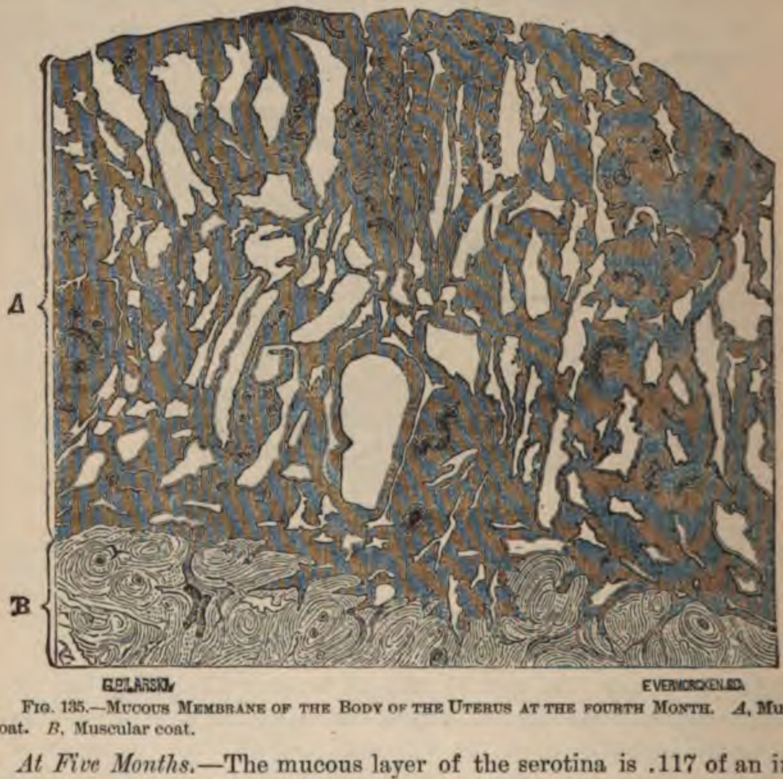


FIG. 135.—MUCOUS MEMBRANE OF THE BODY OF THE UTERUS AT THE FOURTH MONTH. *A*, Mucous coat. *B*, Muscular coat.

At Five Months.—The mucous layer of the serotina is .117 of an inch in thickness, and is situated between the placenta and the muscular coat. The glands are larger and rounder. The compact layer has become thicker, and forms the maternal placenta, which projects into the fœtal placenta, the inter-cotyledonal net-work. At the summit of the villosities, the point of their adherence to the maternal placenta, the epithelial covering of the villi becomes thinner, or even completely disappears; the body of the villus is directly applied to the cells of the decidua. The inter-cotyledonal net-work does not penetrate half way through the fœtal placenta at its centre; while at its edge the net-work goes to the chorion. Thus the cells of the serotina are directly applied to the chorion, either as an elevated cone, on each side of which are villosities and blood-spaces; or as a cone broken into two or three parts; or finally as larger or smaller islands, heaps of cells of the serotina, detached from the cones and thus lost from the fœtal placenta. Hence Winkler and Kölliker claim that the serotina contributes to the formation of the fœtal placenta by furnishing an envelope to the villosities. This is the sub-chorional layer of Winkler.

In the course of the fifth month there appear in the serotina the multinucleated or giant cells, which are found in innumerable quantities in the maternal placenta at term. They develop and multiply with incredible rapidity. At first they appear among the most internal muscular fasciculi of the uterine parieties, especially in the neighborhood of the large vessels and in the deeper layers of the serotina. They soon gain the compact layer, and are found scattered irregularly among the other cells. (See Figs. 134 and 137.)

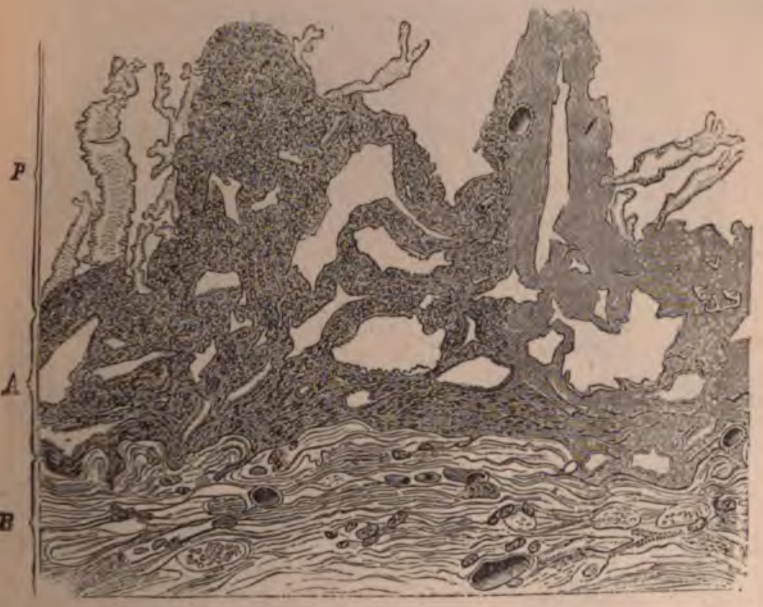


FIG. 136.—INTRA-UTERO-PLACENTAL MUCOUS MEMBRANE AT THE FOURTH AND FIFTH MONTH.—*P*, Placenta. *T*, Mucous coat. *B*, Muscular coat.

The vessels, as at the fourth month, are composed of arteries, the walls of which are thinner in the neighborhood of the villosities, and which dilate as they open directly into the intervillous furrows. Thus the blood passes from the vessels into an immense reservoir of communicating lacunæ, and is returned by the marginal vein and the veins of the serotina (See Figs. 135 and 136.)

The marginal vein collects the blood from the lateral parts of the placenta. It is a large vessel placed at the edge of the placenta, in the space that separates the serotina from the chorion. Its internal face presents several large openings, which communicate with the intervillous spaces. The partitions separating these openings are formed by the villosities themselves, or by the above-described heaps of serotinal cells. Beyond this the venous walls approach one another, communicating frequently by short branches.

Thus the placental circulation is amply provided for. The arteries pour their contents into the blood-spaces; the villosities are plunged in it and bathed by it; and when these have carried off its oxygen, the blood itself passes into the marginal sinus and thence into the veins that ramify at the placental insertion.

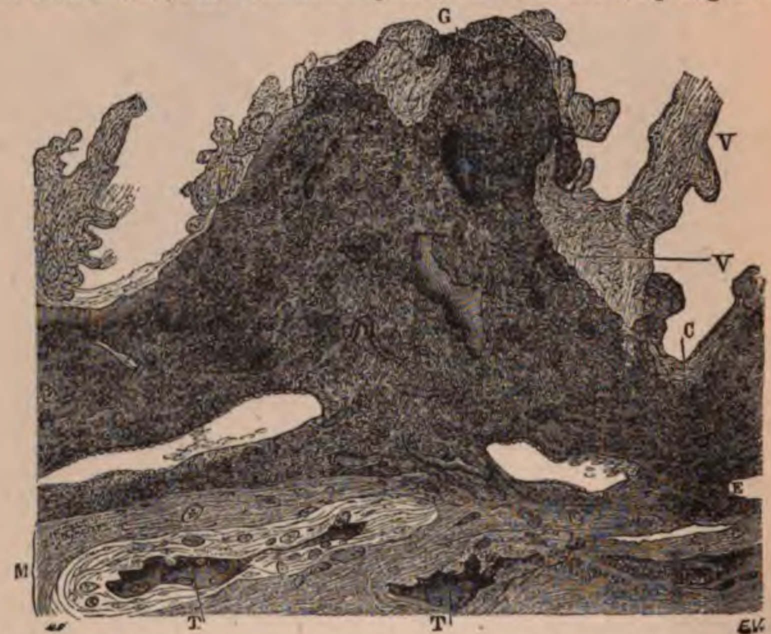


FIG. 137.—PERPENDICULAR SECTION OF UTERUS AND PLACENTA AT THE EIGHTH MONTH OF GESTATION. (After *Leopold.*)—*M*, Muscular coat. *T*, Spontaneous venous thromboses. *C*, Round cells of the serotina. *G*, Giant cells. *VV*, Villosities. *E*, Glandular spaces.

A single thin layer of villous tissue, together with an epithelial coat, are all that separate the umbilical vessels in the villi from the blood of the mother; hence the rapid exchange of material between mother and child.

From the sixth to the seventh month there are no changes of any importance.

At eight months an important phenomenon, to which Friedländer has called attention, occurs. Spontaneous thrombosis takes place in a certain number of veins about the placental insertion, caused by their penetration by the giant cells of the serotina. Situated at first outside and along the veins, they insinuate themselves into the tissues of the vessels, and, once in the interior, cause coagulation of the blood by their presence. (Fig. 137.)

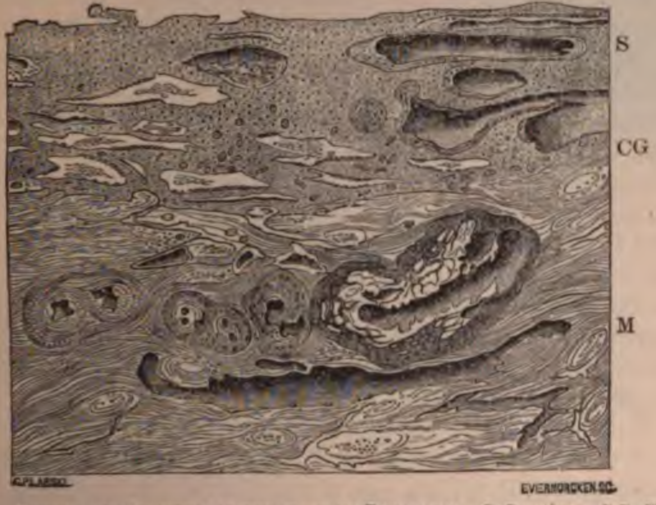


FIG. 138.—UTERUS AND PLACENTA AT THE CLOSE OF PREGNANCY.—*S*, Serotina. *C,G*, Glandular layer. *M*, Muscular coat.

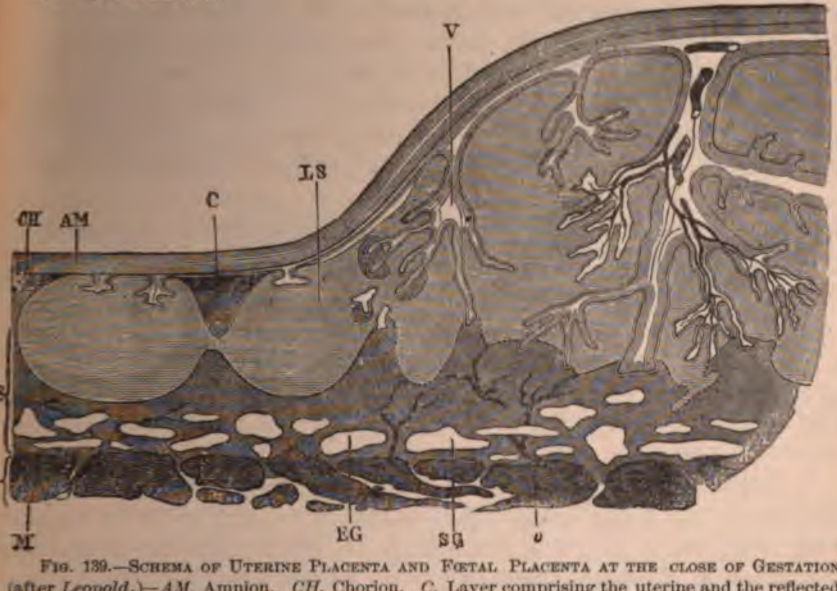


FIG. 139.—SCHEMA OF UTERINE PLACENTA AND FŒTAL PLACENTA AT THE CLOSE OF GESTATION (after *Leopold*.)—*AM*, Amnion. *CH*, Chorion. *C*, Layer comprising the uterine and the reflected decidua. *EG*, Glandular spaces. *M*, Muscular tissue. *S*, Portion of serotina. *LS*, Large blood cavities. *V*, Villosities with ramifications. *v*, Uterine vessel opening into a large blood cavity.

At the Close of Pregnancy (Figs. 138, 139).—There thus exists in the placenta a normal and constant venous stasis. But, if in consequence of too frequent thrombosis, or of an accident to the placental circulation, this venous stasis exceeds its normal limits, may it not produce those sanguineous extravasations and fibrinous bodies which we encounter so often? Might it not compromise the life of the fœtus? Can we not find in it the determining cause of the first uterine contractions and the commencement of delivery? In fact, Brown-Séquard has shown that the irritability of the uterus increases as pregnancy goes on, and that the presence of carbonic acid gas in the maternal blood suffices to excite uterine contractions.

If this last explanation is correct (though, as Kehrer remarks, we must wait for experiments more precise than those of Brown-Séquard), we will find in the venous hyperæmia of the placenta at the close of pregnancy a very important explanation of the appearance of the first pains.

We shall see, when we study the functions of the fœtus, the important rôle played by the placenta.

THE CORD.

The umbilical cord is the organ through which the fœtus communicates with the mother. Until after the allantoic vesicle is formed and the umbilical vessels develop, the cord does not exist. It then forms a conduit folded in the amniotic sheath, and contains in its interior the pedicle of the umbilical vesicle and the pedicle of the allantois. The former pedicle atrophies and becomes filamentous, and the cord itself is formed by the pedicle of the allantois containing the umbilical vesicles and by its amniotic sheath. At first short and thick, the cord becomes gradually thinner and thinner as the abdominal walls and the cutaneous umbilicus are formed. A loop of intestine penetrates a certain distance up the cord, and sometimes ascends so high at the time of the closure of the umbilicus as to constitute congenital umbilical hernia.

As it becomes longer the cord loses its swollen appearance, and it begins to assume a spiral shape at the beginning of the third month. At term the trunk is about as thick as a finger, and is white and polished in appearance. It is more or less transparent and shows the tortuous bluish trace of the umbilical vein.

I. *Length of the Cord.*—18 to 24 inches is the average length; but it is common to find cords longer or shorter than this. The shortest we have seen measured 11.2 inches, the longest 52 inches. Tarnier, in his researches at la Maternité, found one of 6.8 inches, and one of 46.4 inches. Churchill had one 88 inches long, Schneider one 120 inches long. The length of the cord is not without importance for the fœtus, for it is exposed to compression, displacements and entanglements which may more or less compromise the infant's existence.

II. *Volume of the Cord.*—The cord may be fat or lean, as more or less of the gelatine of Wharton is present.

III. *Torsion.*—In the great majority of cases the cord is twisted upon itself from left to right. (Figs. 140 and 141.)

Tarnier, in 550 cords found twisted to the left 505; to the right 45.

Neugebauer, in 150 cords found twisted to the left 114; to the right 39.

Hecker, in 315 cords found twisted to the left 245; to the right 70.

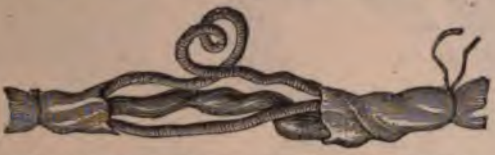


FIG. 140.—TWISTING OF A SINGLE UMBILICAL ARTERY.

The cause of this torsion has been variously attributed to the gyratory movements of the embryo, to the fact that the vessels develop more rapidly than the sheath, etc. We do not know the cause with certainty.

The number of spirals varies greatly: Thus, Kilian has seen 12 to 17, Blume 33, Dohrn 85, and Meckel 95. In these cases Wharton's jelly may be entirely absent at the twisted points, and the life of the infant may be endangered from embarrassment of the circulation. Complete atresia and death of the fœtus may follow (cases of Meckel, Dohrn, Blume, Kilian, d'Outrepont, Elsässer, etc. (Figs. 142 to 147.)

In some twin births the cords are united or laced together. Chantreuil has collected a number of these cases.

We often find nodosities due to excess of gelatin and angles formed by twisting of the vessels. (See Figs. 140 and 141.)

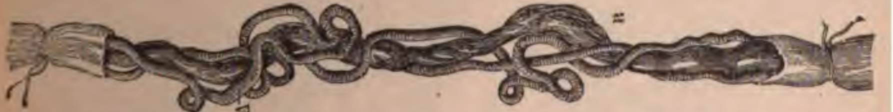


FIG. 141.—TWISTING OF TWO UMBILICAL ARTERIES.—*A*, Swelling of the artery. *B*, Varicose swelling of the vein. (*Tarnier.*)

IV. *Insertion.*—The cord stretches from the cutaneous umbilicus to the placenta. A prolongation of skin from the umbilicus encircles it for a short distance.

The skin ceases abruptly at the level of its continuity with the cord, and at this point there is a capillary circle that embraces the base of the cord, and extends up it for several lines. This vascular circle is in connection with the artery and vein of the abdominal skin at each side of the median line of the body. The epidermis of the body above is continuous with the epidermis of the cord. These capillaries, after running some 2-3 lines to the edge of the skin, return and pour their blood into the circular vein.

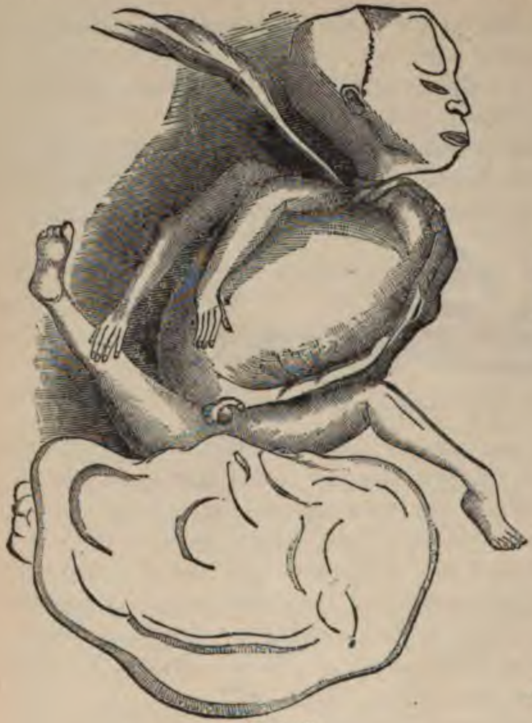


FIG. 142.

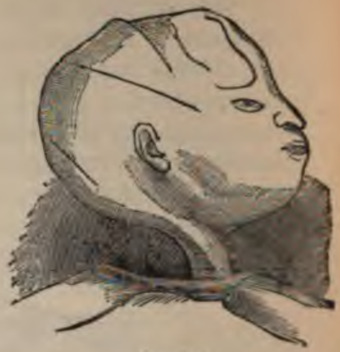


FIG. 143.

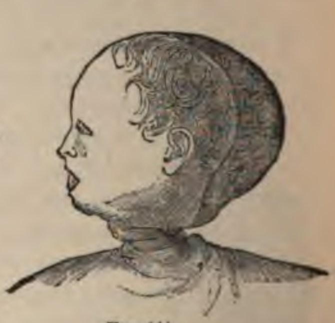


FIG. 144.

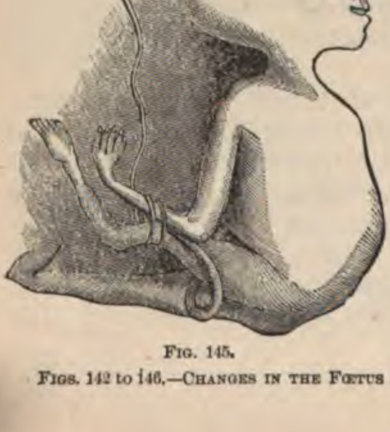


FIG. 145.

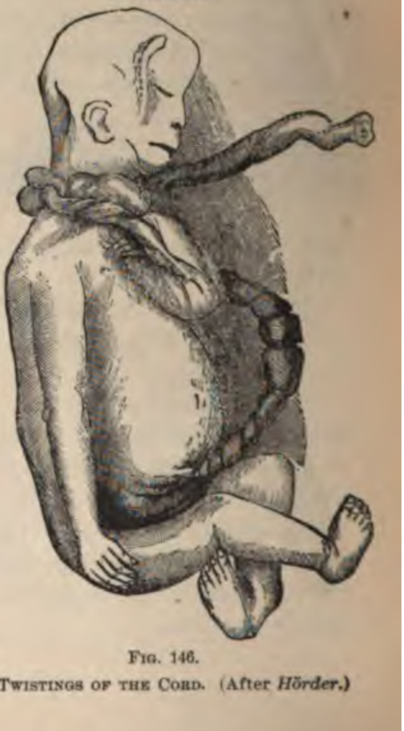


FIG. 146.

FIGS. 142 to 146.—CHANGES IN THE FŒTUS CAUSED BY TWISTINGS OF THE CORD. (After *Hörder*.)

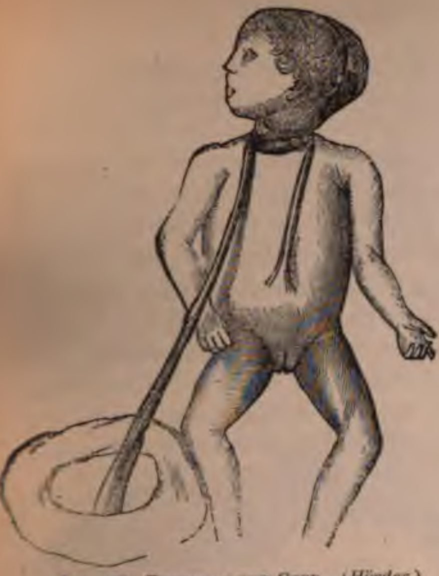


FIG. 147.—TWISTS IN THE CORD. (*Hörder.*)

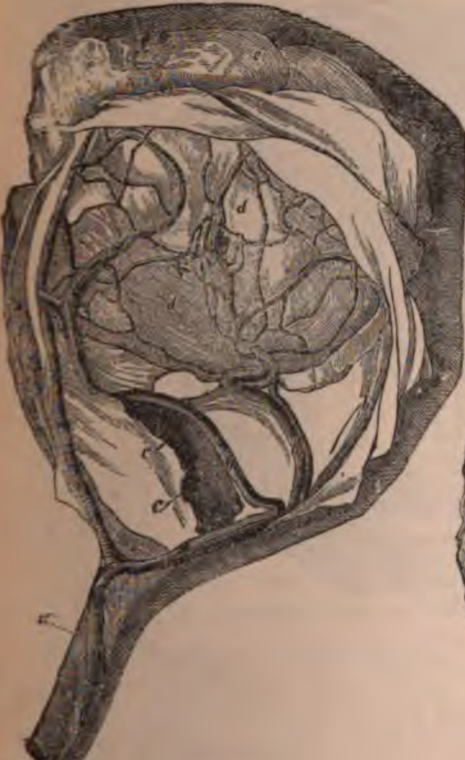


FIG. 148.

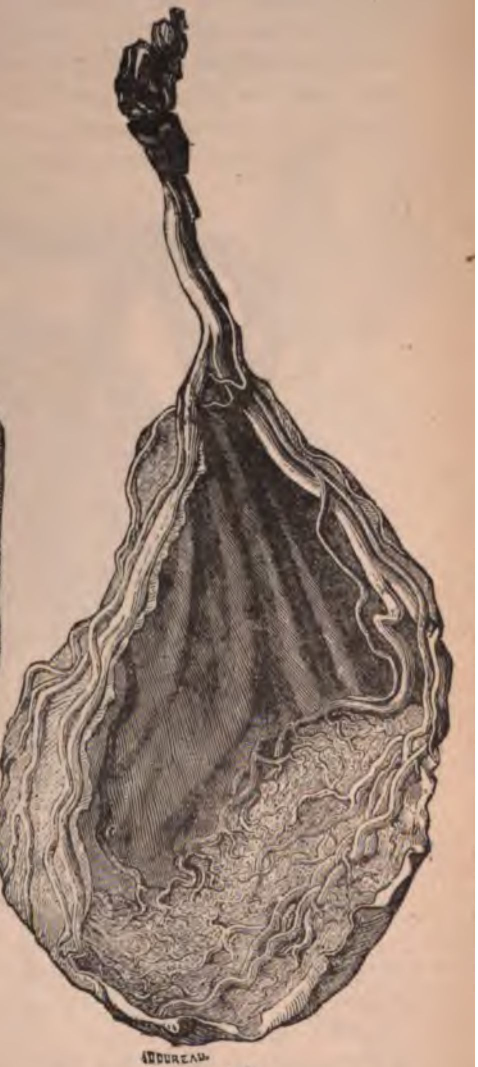


FIG. 149.

FIG. 148.—VELAMENTOUS INSERTION OF THE PLACENTA.—*a*, Cord. *b*, *b*, Vessels of the cord. *c*, *c*, Rupture site of the membranes. *d.d*, External surface of the placenta. (*Martin.*)

FIG. 149.—VELAMENTOUS INSERTION. (After *Lobstein.*)

This disposition of the skin and its vessels explains the fact that the cord always atrophies to the level of the skin, no matter where the cord is tied.

The placental insertion of the cord is not absolutely fixed. When situated at or near the centre of that organ, it is termed central; when placed near the edge, it is called marginal. (Fig. 149.) In the latter case there is always a dissociation of vessels that border on different points of the placental circumference. In a few cases, less rare perhaps than is generally supposed, for we have ourselves seen three instances, the cord does not go to the edge of the placenta, but penetrates the membranes, and accompanies them for a longer or shorter distance. This is the velamentous insertion (Fig. 150); and beyond this point the vessels reach the edge of the placenta, travelling either together or alone in a forked manner so as to form the forked insertion. (Fig. 148.)

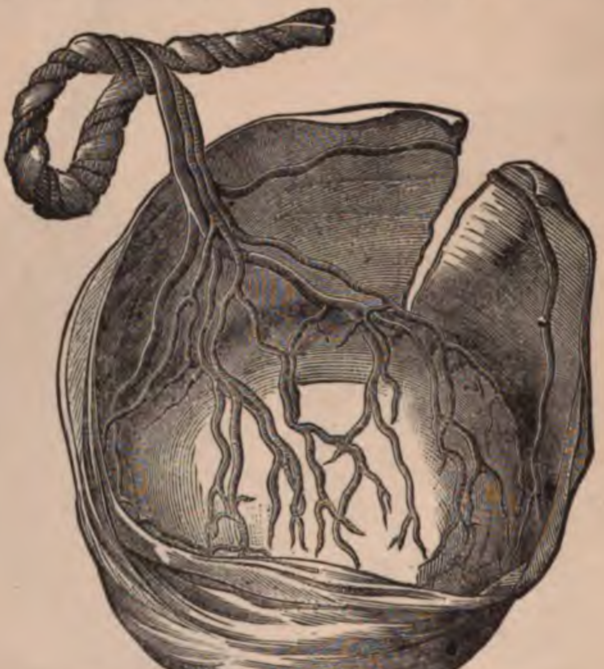


FIG. 150.—VELAMENTOUS INSERTION. (After *Benkiser.*)

Finally, Chantreuil has mentioned exceptional cases in which the cord adheres to the body of the embryo, or to the amnion, or when the branches adhere to one another. They coexist almost always with placental adhesions, or with fœtal monstrosities. Further, the anomalies and lesions of the umbilical vessels, and the tumors of the cord which are associated with the hydatid mole, are to be mentioned.

V. *Structure.*—The cord is composed of the arteries and the umbilical vein, surrounded by Wharton's jelly, a transparent, colorless, gelatinous substance (inter-annexial tissue of Dastre), in which Renaut distinguishes a mucoid tissue properly so-called, and a peri-vascular tissue. In rare cases there are two umbilical veins and a single artery. The arteries run side by side, and form a spiral chain around the vein. According to Hyrtl, each vessel possesses besides this a twist proper to itself, turning spirally upon its own proper axis. Hyrtl and Berger have proved, by means of inflated and dried cords, that the arteries and veins are provided with valves composed of the full thickness of the walls. The arteries possess but one internal coat, so that the blood only progresses under the influence of the fœtal heart beat. The valves may be semilunar or circular, and sometimes several of them unite to form a perfect diaphragm pierced by a hole in the centre. The number of valves in the vein is very variable. Veins that are not at all or but little tortuous, have no valves, or only traces of them. Very tortuous veins, on the contrary, very often have a large number of valves a few lines in height. Berger denies that these are valves, and calls them simply semilunar folds.

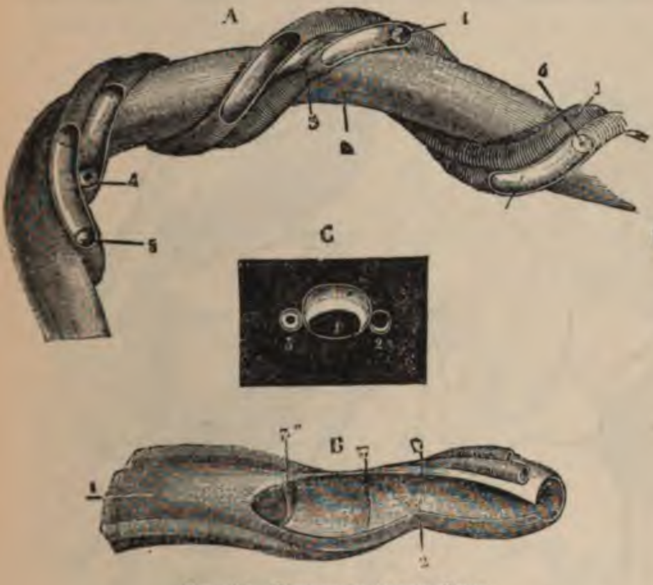


FIG. 151.—STRUCTURE OF THE CORD.

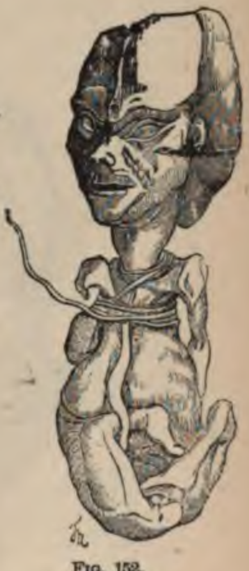


FIG. 152.

FIG. 151.—*A*, Umbilical arteries. 1, 1′, Rolled round the vein, 2. 3, 3′, Narrowing at the folds. 4, 4′, Semi-lunar folds. 5, 5′, Diaphragmatic folds. *B*. 1, Vein open on its lateral surface, narrowed at 2. 3, 3′, 3″, Semi-lunar folds. *C*, Section of the vein and artery, perpendicular to their longitudinal axis. 2, Semi-lunar fold. 3, Diaphragmatic fold.

FIG. 152.—TRÉLAT'S SPECIMEN.

The cord has no lymphatic vessels. Schatt and Valentin have described nerve filaments, which Kölliker has been able to follow to 3 to 4 inches from the umbilicus. Virchow, on the other hand, denies their existence.

VI. Rings formed by the cord may encircle various parts of the fœtus. They have been found as follows in order of their frequency:

1st. *Around the neck.*—Usually one or two coils, though we have seen three and four. Chantreuil, Rouzé, Bailey, and Campbell have seen six coils, Baudelocque seven, and Mme. Waldwogel eight.

2d. *Around the Trunk,* when they may or may not include the members.

3d. *Around the Members.*—As a rule there are at the same time coils around the neck or trunk, or more or less complicated twists and knots. A most curious case of this kind has been described by Trélat. (Fig. 152.)

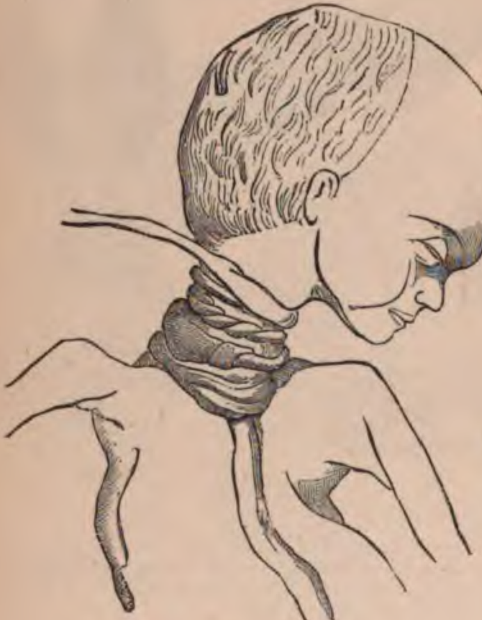


FIG. 153.—BLUME'S CASE.

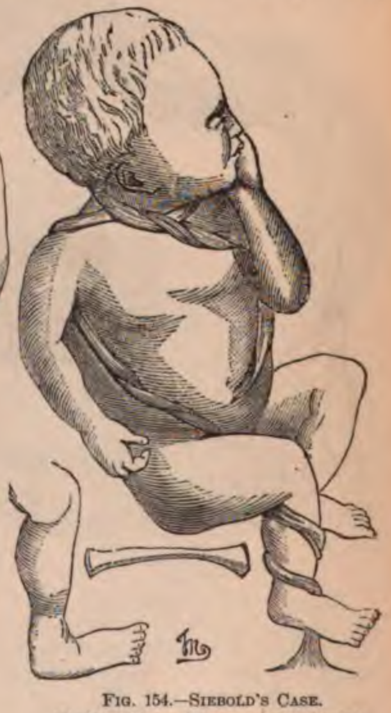


FIG. 154.—SIEBOLD'S CASE. (Reduced from *Nonancourt's* thesis.)

Rings of the cord are of common occurrence, being found at least once in every 5 or 6 deliveries. As a rule they encircle the neck; in 967 cases observed at the Clinic, 953 cases were of that variety, against 14 cases where trunk or members were involved. The causes are: Length of the cord, excess of liquor ammni, a small fœtus, exaggerated movements of mother and child, and finally, certain individual predispositions.

The signs are either those of accidental or relative shortness of the cord, which we shall shortly consider, or other signs peculiar to these bands. Thus Charrier and Winckel have plainly felt, by abdominal palpation, a loop of the cord running across the back of the fœtus. In a certain number of cases a bruit de souffle called the umbilical souffle may be detected; it is isochronous with the fœtal pulse. These signs are neither constant nor certain.

But these usually harmless loops and bands of the cord may in some cases hinder labor, or even cause the death of the child. Mayer saw 49 out of 685 cases of this kind die, 18 fatal cases of which were due solely to the existence of the loops. Veit, in 442 cases, records 63 as apparently stillborn, and seven as dead. The dangers depend upon the presentation, the seat and number of the bands, and the degree of constriction. In breech presentations and when around the neck they are most dangerous. Elsewhere it is only the possible compression of the cord which may compromise the life of the fœtus. For not only may asphyxia result from the compression, but the obstruction to the return circulation may cause congestion of the brain; and the pressure may even result in the cutting through of soft and hard parts by the ligature. Cases of this latter kind have been reported by Bailey, Blume (Fig. 153), Siebold (Fig. 154), Bartscher, Heyfelder, Eichorn, Credé, Buchanan, Owen, Morgagni, Montgomery, Adams (Fig. 155), Beaty, (Fig. 156), Hillairet, (Fig. 157), etc. See also Figs. 142 to 147.

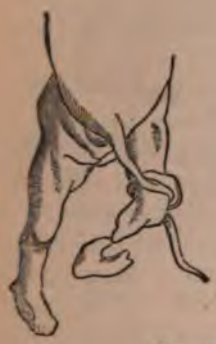


FIG. 155.

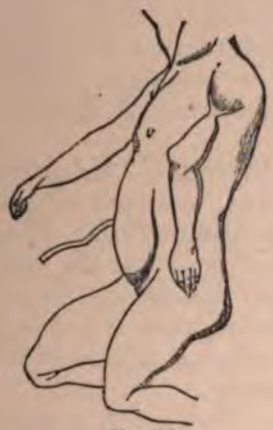


FIG. 156.

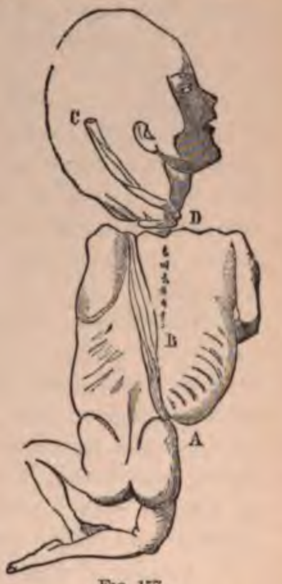


FIG. 157.

FIG. 155.—ADAMS' CASE. Fœtus of three months.

FIG. 156.—BEATY'S CASE. Fœtus of four months, presenting on left arm a deep depression due to twist of the cord.

FIG. 157.—HILLAIRET'S CASE.

During pregnancy there is no treatment for this accident. At labor the only thing to do is to disengage the entangled parts as rapidly as possible, and, if this cannot be done, to cut the cord and end the labor with all possible speed. If the child is endangered before the head is engaged, apply the forceps.

In twin-births entanglements with the cord are rarer. Chantreuil states that Fricke found only 9 cases, 5 of bands, 2 of knots, and 1 of knots and bands. In these 9 cases there were 4 deliveries at term, 2 between 7 and 8 months, and 3 abortions at the third to the fourth month.

VII. Shortness of the cord may be absolute or natural, or relative, from twists and knots. The shortest recorded cords are those of Sclafer, which was hardly half an inch long; Malgaigne, 2.7; Meissner, Reale, 4.5 inches; and Depaul, 4.8. Mason Good, Stute, Mme. Danthez, and Thouret have recorded cases in which the cord was entirely wanting.

A cord is short when there is not enough of it to permit the expulsion of the fœtus without detachment of the placenta.

Devilliers has shown that the cord, when of normal length, and free, gives us more than sufficient length for the expulsion of the fœtus; but each band and knot lessens the amount of free play. In some cases absolute shortness of the cord has been found coincident with certain deformities, and Carus and Froebel claim that they bear the relation of cause and effect.

Symptoms.—a. *Absolute Shortness.*—During pregnancy considerable pain is felt at the fundus uteri, and the fœtal movements, though very limited, cause great distress. During labor, dilatation is very slow, in spite of frequent and severe pains. At the intervals of the pains the uterine walls retain a certain hardness. The umbilical souffle may be heard; and finally, in some cases, there is a sense of resistance, followed by tearing with a snap, indicating rupture of the cord. These signs, however are rather hypothetical.

b. *Accidental Shortness.*—Though still uncertain, the symptoms are more important. During pregnancy, according to Devilliers, pains occurring weeks or days before delivery, and felt in the region of the kidneys; premature rupture of the membranes, though we think this the exception rather than the rule; diminished extent of motion, or very disordered or brusque movements of the fœtus; elevation of the fundus uteri even at an advanced period of uterine dilatation; and lastly, the fœtal souffle.

During labor.—The symptoms are: a tedious labor, due to feebleness and slackness of the pains, the membranes being ruptured and dilatation of the os complete, and there being no apparent obstacle to delivery on the side of either the mother or the fœtus. Sometimes the pains continue regularly, but the advance of the fœtal part is slow and difficult; the pains are, as it were, cut in half, and are not as expulsive as they should be. There is a painful point at the umbilicus, corresponding to the fundus uteri. The uterus remains hard during the intervals of contraction, and there is a species of erythism similar to that produced by ergot.

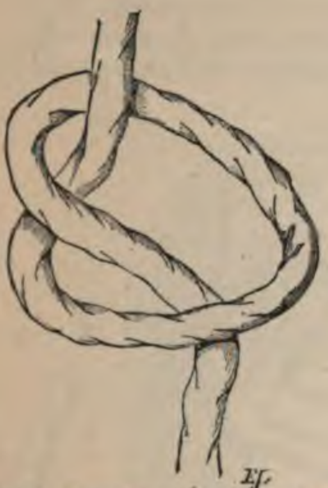


FIG. 158.—SIMPLE KNOT. (This, with the following figures, is taken from Read's memoir.) *Knots on the umbilical cord. The American Journal*, 1861.

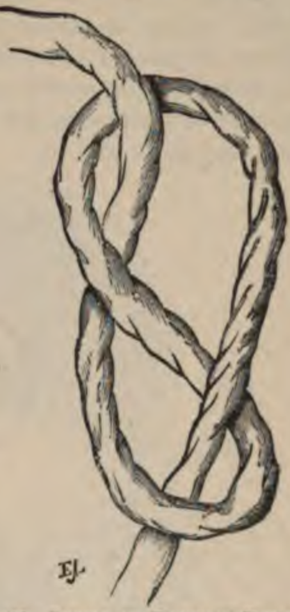


FIG. 159.—DOUBLE, OR FIGURE-OF-EIGHT KNOT.

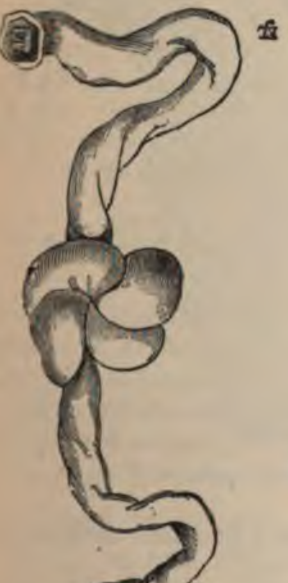


FIG. 160.—BAUDELOCQUE'S KNOT, AS FOUND AT BIRTH.

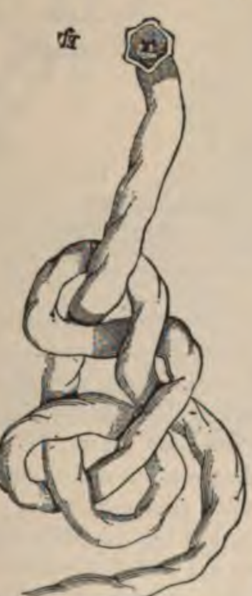


FIG. 161.—BAUDELOCQUE'S KNOT IN PROCESS OF FORMATION.

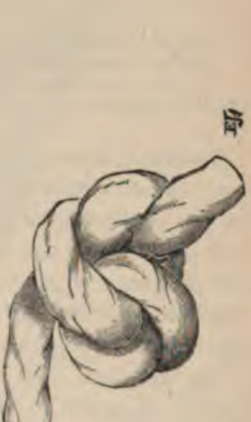


FIG. 162.—KNOT THAT LEYMAN FOUND AT BIRTH.

The movements of descent and retreat of the head are not really apparent at the lower part of the pelvic canal; they are rather due to the resistance of the perineum and of the soft parts. The umbilical souffle; irregular fœtal heart sounds; a premature flow of meconium; hemorrhage before or just at the moment of fœtal expulsion; and lastly, tension of the cord, only appreciable exceptionally and very late; these are the principal signs. They are not characteristic, for they may all occur with other conditions; and they may all be wanting.

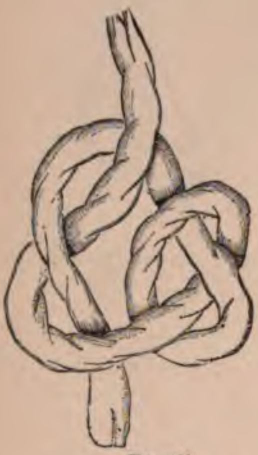


FIG. 163.

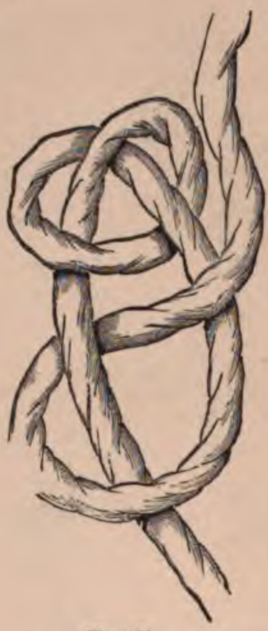


FIG. 164.

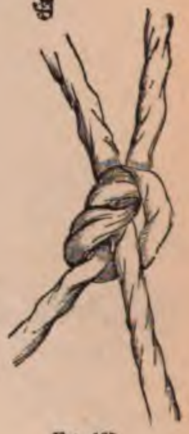


FIG. 165.

FIG. 163.—LEYMAN'S KNOT. INTERMEDIATE FORM.

FIG. 164.—LEYMAN'S KNOT. AS IT MUST HAVE BEEN AT THE TIME OF ITS FORMATION.

FIG. 165.—KNOT DESCRIBED BY W. NEWMAN. It is formed of the cord of one child, and the cord of the second child passes through the mesh.

Demeaux, Zeller, Osiander and Joerg believe that shortness of the cord may cause abnormal fœtal presentations. It has certainly sometimes caused displacement of the placenta, partial or total rupture of the cord, and inversion of the uterus. Though of small importance to the mother, the prognosis is more serious for the child; and since interference is often required, shortness of the cord is a real cause of dystocia, and will be considered in the chapter upon that subject.

At first wait, then rupture the membranes, and terminate the labor as quickly as possible; such is in brief the treatment.

VIII. *Knots of the Cord.*—Knots of the cord may be simple (Fig. 144) or complicated, single or multiple. (Figs. 145 to 152.)

Chantreuil divides knots into old knots, formed during pregnancy, the tissues of which are compressed and atrophied, and recent knots, formed during labor.

Among the causes of these knots may be mentioned, length of the cord, abundance of liquor amnii, and exaggerated movements of the mother and the fœtus. These knots, while sometimes harmless, occasionally compromise the life of the child. Lee has cited a case in which circulation became absolutely impossible; more recently Guéniot, in a case of twin pregnancy, lost both children from the existence of a hard square knot that united both cords. Blot, Tarnier, Depaul have denied, in the academic discussion of this subject in 1881, the possibility of this occurring. Tarnier

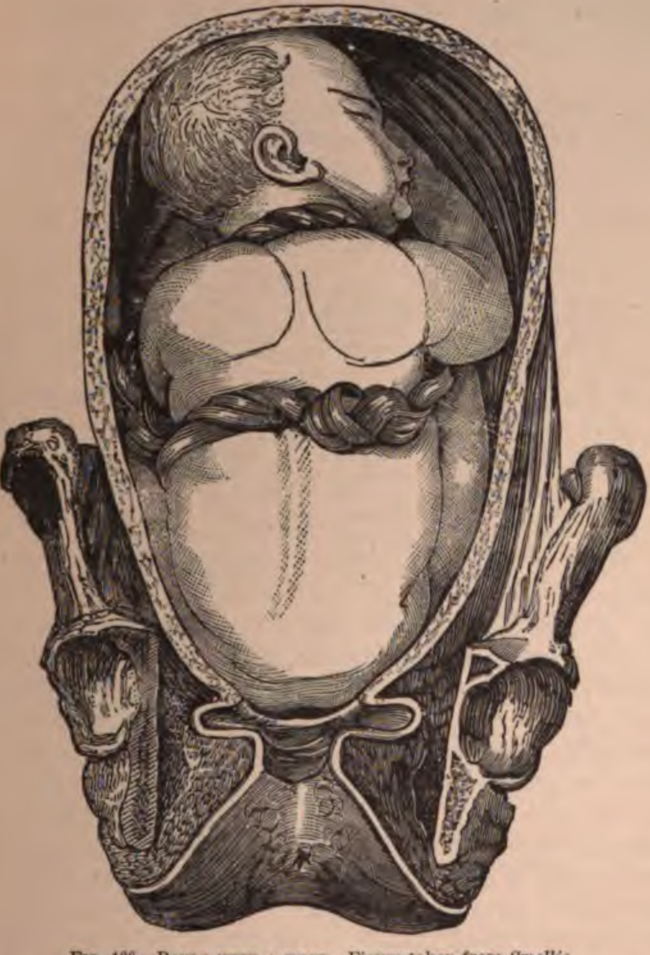


FIG. 166.—BANDS WITH A KNOT. Figure taken from *Smellie*.

claimed that at least three knots were necessary to interrupt the circulation; Blot and Depaul would not even admit this, the latter having seen an infant born living, the cord of which showed five contiguous knots. We ourselves have always seen the cases where there were knots on the cord born alive, and we regard the case of Lee as altogether exceptional.

CHAPTER III.

THE FŒTUS.

HAVING studied the development of the ovum, from its earliest known stage to the ninth month of utero gestation, we will proceed to consider its functions and constitution after birth.

Fehling gives a table containing the quantitative analysis of the constituent elements of twenty-one fœtuses at different periods of pregnancy. The table below shows the weight of the fœtus at different months.

INCREASE IN WEIGHT OF THE FŒTUS DURING THE MONTHS OF PREGNANCY.

AGE.	Weight of body in grains at the beginning of the period.	Absolute monthly increase in grains.	Absolute daily increase.	Relative monthly increase.	Relative daily increase.
2d month of pregnancy,	15.43	46.29	0.15	46.29	1.5
3d " "	61.72	246.88	8.7	61.72	2.19
4th " "	308.6	1543.	55.	77.15	2.74
5th " "	1851.6	2545.95	90.88	19.90	0.75
6th " "	4397.55	5400.50	192.87	18.82	0.67
7th " "	9798.05	9026.55	322.48	14.19	0.49
8th " "	18824.6	7406.40	263.85	6.01	0.21
9th " "	26231.	8332.20	295.94	4.78	0.16
10th " "	34563.2	23584.30	547.76	6.94	0.23
At term	50147.5	....	......	.....	....

Hecker, Duncan, and Wernich have studied the conditions hindering or favoring fœtal growth. Wernich arrives at the following conclusions:

1st. The weight of new-born children increases constantly with the age of the mother up to the twenty-ninth year, and their length increases with the age of the mother up to the forty-fourth year. (Duncan.)

2d. The product of each pregnancy exceeds in weight and length the product of preceding pregnancies.

3d. The age of the mother and the number of her pregnancies influence the increase in weight and length of the fœtus, each factor being expressible as a progression. The coincidence of a certain pregnancy with the medium age of the woman is particularly favorable to the development of the fœtus. (Hecker, Wernich.)

4th. Very long intervals between successive pregnancies have less effect upon the progressive increase in weight than very short intervals. (Wernich.)

5th. Change of sex lessens the increase in weight of children, to the detriment of later female infants.

6th. The first children of mothers who have begun to menstruate very late are inferior in weight to the first children of mothers who have menstruated early.

THE FŒTUS AT TERM.

Weight and Dimensions of the Fœtus.

The weight of the fœtus at term, as we have seen, varies between six and one half and seven pounds; it oscillates between four and seven pounds. Below four pounds, the fœtus is either not at term, or is in a pathological condition. We have seen that, according to Schroeder, the fœtus weighs at seven months from two to two and one-half pounds (it not being forgotten that the Germans divide the period of pregnancy into ten months of four weeks each.) The mean weight for us at seven months is three to three and one-half pounds, corresponding to the eighth month of the Germans. Below this figure the child would not be viable, though we have seen a child one week younger than that, and weighing only two and one-tenth pounds, which was successfully reared, it being twelve days before it was able to take the breast. On the other hand, infants of seven and one-half to eight pounds and more, are not absolutely uncommon, though those weighing over ten pounds are very rare. We ourselves have seen two, one weighing ten and one-quarter pounds, and the other ten and one-half pounds. Madame La Chapelle records one of twelve and one-tenth pounds, Baudelocque one of 13.05 pounds, Merrimann one of 15.5 pounds, Groft one of sixteen pounds, and Cazeaux has described a child that weighed eighteen pounds. [Anna Swann, a giantess, was delivered of the largest child on record, weighing 23 pounds.—Ed.]

As to length, they vary from 20 to 22.4 inches. The heaviest children are not always the longest. The cord is not inserted into the median part of the fœtal body; it is generally placed below that point. According to the records of the Clinic, we find that in, for example, an infant 20 inches long, vertex to umbilicus measures 10.4 to 11.2 inches, and from umbilicus to great toe-nail, 11.2 to 8.8 inches; but the point of insertion varies greatly.

The fœtus at term has a rosy skin covered with a more or less abundant sebaceous coating, and a down which is well developed in poor and feeble infants, but is much less abundant on those that are strong and vigorous.

The nails project beyond the extremities of the fingers, and reach the tips of the toes; the testicles are in the scrotum. The labia minora are generally covered by the labia majora; the nipples are prominent; the infants cry and move vigorously, and void urine and meconium.

Ribemont has called attention to several interesting points. First there is the enormous development of the thymus, which is ordinarily voluminous enough to completely cover the auricles, and even partly to cover the anterior surface of the ventricles, from which it is separated by the pericardium. The heart is pushed by the thymus far from the sternum. The first respiratory efforts of the infant carry the heart inward, so that its apex, which corresponds to the fifth intercostal space, and which, in the child that has not breathed, is one-fifth of an inch from the median line, is pushed to only one-tenth of an inch from that line. Contrary to the general opinion Ribemont has shown that the heart is nearer by two-fifths to three-fifths of an inch to the pelvic than to the cephalic extremity. This is important in reference to auscultation. Béclard has thought to find in the point of ossification of the inferior epiphysis of the femur, a positive sign of the maturity of the fœtus. (Fig. 167). But the researches of Hecker and of Hartmann have shown, that the point of ossification, with its diameter of one-fourth of an inch, may be found in infants manifestly before term; and that it may be wanting in infants at full term. Hartmann, in forty fœtuses of eight months, found it twice; in sixty fœtuses of nine months found it sixteen times; in forty-six at ten months, twenty-seven times; and in one hundred and two infants at term, he proved its absence twelve times.

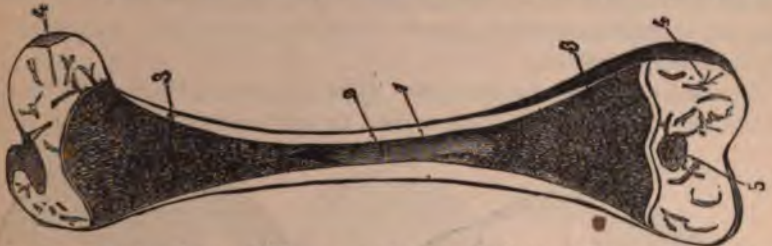


FIG. 167.—FEMUR OF CHILD TWO WEEKS OLD. 1, Compact substance of the diaphysis. 2, Medullary canal. 3, Spongy substance of diaphysis. 4, Cartilaginous epiphysis with its vessels. 5, Point of ossification of the epiphysis.

Head of the Fœtus at Term.

The head of the fœtus is oval, with the larger extremity posteriorly. It is composed of face and cranium.

The face (Fig. 168) is composed of fourteen bones, two being single, the inferior maxilla and vomer; and six being double, the superior maxillæ, the palate, the lachrymal, the nasal, the inferior turbinated and the molars.

The cranium (Fig. 169) is composed of eight bones. Four, the frontal, occipital, sphenoid and ethmoid, are single; and two, the parietal and temporal, are double.

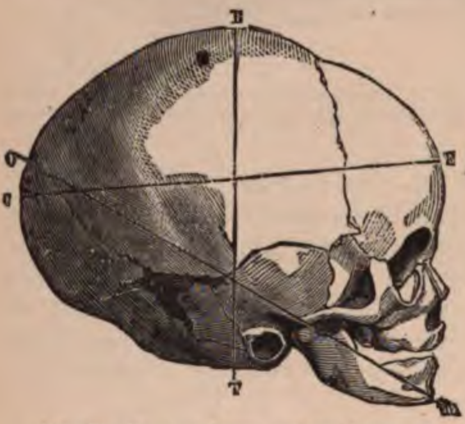
The vault of the cranium is formed in front by the frontal bone, on the sides by the parietal and the squamous plate of the temporal, and behind by the occipital. The base is composed of the basilar portion of the occipital, the sphenoid, the ethmoid, and the petrous portion of the temporal. Whilst the bones of the base are firmly united to one another, those of the vault of the skull are separated from each other by considerable membranous intervals, and allow an amount of motion and overlapping which permits within limits a reduction in the size of the head, which is important at the time of birth.

These membranous spaces are the sutures and fontanelles; and, following Budin, we will add to them the occipital hinge.

There are five sutures, the frontal, sagittal, lambdoid, and two temporo-parietal. The first three only are of importance to the accoucheur, since they only can be appreciated by the touch.

The frontal or fronto-parietal suture separates the two parietals from the frontal; it runs transversely across the skull, and is crossed at its middle by the sagittal suture.

The sagittal or great suture runs from the root of the nose to the apex of the lambdoid suture. It is crossed by the frontal suture.



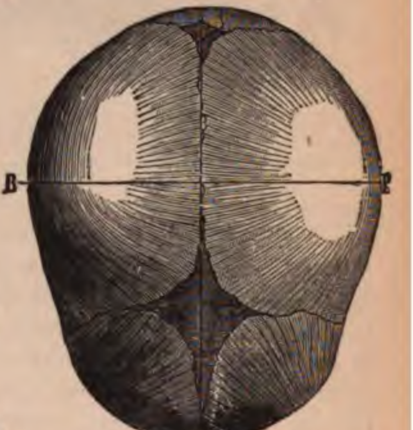


Fig. 168.—Head of Fœtus at Term (profile.) *OF*, Occipito-frontal diameter. *OM*, Occipito-mental diameter. *BT*, Vertical diameter.

Fig. 169.—Head of Fœtus at Term. (Vertex.) *BP*, Biparietal diameter.

The occipito-parietal or lambdoid suture (*Δ* of the Greeks), lies between the posterior borders of the parietals, and the ocipital. Its apex touches the posterior end of the sagittal suture, and its extremities end at the squamous plate of the temporal.

When the head is compressed in the pelvis, these sutures project instead of being gutter-shaped, from the sliding of the bones on each other.

The fontanelles are the membranous spaces where the sutures meet. We have:

1st. *The Anterior or Great Fontanelle, or Bregma or Bregmatic Fontanelle.*—Formed by the union of the fronto-parietal with the sagittal suture, it is of quadrangular shape, and has four angles and four borders. The anterior angle is formed by the divergence of the two halves of the frontal, and the posterior angle by the uniting parietals; the two lateral angles are made by the divergence of the halves of the frontal from the parietal of the same side. The edges are formed by the borders of the frontal and the parietals. (Fig. 169.)

Each angle is continuous with a suture, and this, together with its quadrangular shape, enables us always to distinguish it from one of the supplemental sutures, which are accidental, and smaller membranous spaces along the sagittal suture.

2d. The small or posterior or occipital fontanelle is situated at the point of junction of the sagittal and the lambdoidal sutures. It is triangular, and much smaller than the anterior fontanelle; its three angles are formed by the occipital and parietal bone. Velpeau has shown that in certain cases the occipital is, like the frontal, divided into two halves; but this posterior prolongation of the sagittal suture is always much shorter than the anterior one. (Fig. 169.)

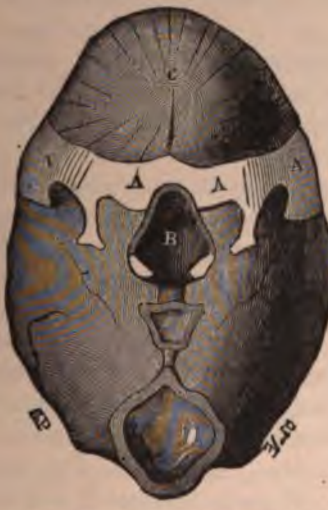


FIG. 170.—(After *Budin*). *A*, Occipital hinge. *B*, Occipital fossa. *C*, Occipital bone.

Budin has shown that between the basilar portion of the occipital and its squamous part, there is a sort of fibro-cartilaginous joint, permitting movements of flexion and extension. It is rapidly ossified after birth.

Finally, at the extremities of the lambdoid suture are the two fontanelles of Gasser, which are covered by the soft parts so completely as not to fall under our observation as accoucheurs. (Fig. 168.)

Diameters and Circumferences Of the Head.—We distinguish antero-posterior, vertical, and transverse diameters.

The antero-posterior diameters are:

1. The occipito-mental diameter, which, running from the occipital protuberance to the chin, measures 5.4 inches.

The occipito-frontal diameter, O.F., extending from the occipital protuberance to the root of the nose, measures 4.6 inches.

3d. The sub-occipito-bregmatic, S.O.B., runs from the point of meeting of the occipital and the nucha, at the middle of the great fontanelle, at the level of the point where the sagittal and fronto-parietal sutures cross; it measures 3.8 inches.

The vertical diameters are:

1. The mento-bregmatic, M.B., from the chin to the centre of the great fontanelle; it measures 4.4 inches.

2. The trachelo-bregmatic, Tr.B., or sub-mento-bregmatic, S.M.B., traverses the head perpendicularly, from the bregma to the anterior part of the occipital foramen; it measures 3.8 inches.

The transverse diameters are:

1. The bi-parietal, B.P., the maximum transverse diameter of Budin, goes from one parietal tuberosity to the other, and measures 3.8 inches.

2. The bi-temporal, B.T., the minimum transverse diameter, extends from the point of beginning of the parieto-frontal suture of one side to a similar point upon the other side. It is 3.2 inches long.

The bi-mastoid stretches from the one mastoid process to the other. It measures 3 inches (Figs. 168, 169).

These dimensions are those of the undeformed head; but during its passage through the pelvis the fœtal occiput undergoes certain modifications to which Budin has called attention. These modifications are normal. After having studied and compared the results of English and German investigators, Budin arrives at the following conclusions:

Under the influence of the compression of the head by the pelvis, there occurs a sliding and overriding of the bones at the sutures, so as to produce a deformity varying with the different presentations. To this we will return later; but the following points may be here noted:

> In vertex presentations, diminution of the diameters O.M. and O.F;
> Increase of the maximum diameter sub. O.M;
> Diminution of the sub-O.Breg. and B.T. diameters;
> Diminution less pronounced, of the diameter B.P;
> Irreducibility of the bi-mastoid diameter.

These ideas differ, as is evident, from those heretofore held.

> In breech presentations—little or no modification of the head.
> In face presentations, increase of the diameters O.M. and O.F.
> Decrease of the diameters M. Breg. and S.M.B.

In the trunk he distinguishes the following diameters:

Bi-acromial	4.4 inches.
Sterno-dorsal	3.8 "
Bi-iliac	3.2 "
Bi-trochanteric	3.6 "

FUNCTIONS OF THE FŒTUS.

Nutrition of the Fœtus.

The nutrition of the fœtus passes through phases which correspond to the different epochs of fœtal development.

Before the allantois is formed, the ovum derives its nourishment from the cells that form the discus proligerous; later it is sustained, through its first villosities, from the albuminous material enveloping it, and the liquid secretions of the uterine mucous membrane.

The embryo once formed, it is the umbilical vesicle which, with the aid of the omphalo-mesenteric vessels, furnishes the fœtus with the materials necessary for its growth. But it is only when the allantois has conducted the umbilical vessels into the chorional villi and the placenta is formed, that fœtal nutrition is definitely established. The placenta is the essential organ through which the fœtus can draw from the maternal organism the elements necessary for its growth.

The theory that the amniotic fluid was swallowed and digested by the fœtus has fallen back into the obscurity from which it ought never to have emerged, and all authors are in accord in viewing the placenta as the essential organ of fœtal nutrition. But whilst the existence of utero-placental vessels—of direct anastamoses between the maternal and fœtal vessels—was admitted thirty years ago, modern authorities only have recognized the peculiar structure of the chorional villi, and the absolute independence of the two circulations, and have sought for other explanations.

Eschricht and Ercolani thought that the villi could draw the elements of nutrition from the uterine glands. Others have supposed that osmosis through the epithelial membranes that separate the two circulations explained the nutrition of the fœtus; they confounded the respiration of the fœtus with its nutrition.

Cl. Bernard, Zunz, Benicke, Zweifel, Fehling, and Gusserow have especially contributed to the elucidation of this problem. Bernard has called attention to the glycogenic function of the placenta. It is only a temporary function; for as the liver is developed, the glycogenic material furnished by the placenta tends to diminish, until it almost entirely disappears during the last months of pregnancy.

Cl. Bernard, in demonstrating the existence of cellular elements whose function it is to elaborate the glycogenic material, has demonstrated by that fact alone, as Pinard claims, the passage of the elements constituting that material through the epithelial membranes of the villi.

But do all the materials pass?—And under what forms do they do so?

For experience teaches that while gaseous and liquid substances may thus pass, solids, no matter how finely subdivided, cannot do so.

Hoffmann and Langerhaus tried cinnabar, Jassinsky carmine, Fehling india ink, Davaine and Ballinger blood charged with bacteria, without being able to find any of these substances in the fœtal blood. Ahlfeld was as unsuccessful with madder and indian ink, and showed that in pregnant bitches, fed exclusively upon fatty food, and whose blood was surcharged with fat—not a single fat globule could be found in the fœtal blood.

On the other hand, Fehling proved that these same fatty substances in solution, together with proteid and mineral substances, could pass into the fœtus. Benicke demonstrated the passage of salicylic acid, Gusserow of iodide of potassium and some liquid substances; Zweifel showed the passage of chloroform, and Fehling that of carbonic acid gas.

Sinçe then Thomas has tried morphine, Clouet phosphorus, de Lados arsenic, Constantin Paul and Baker lead, with success. It is demonstrated that the placenta is the essential nutritive organ of the fœtus. But there is neither a digestion, properly so called, nor any absorption. The nutritive principles are injected directly into the blood of the fœtus.

Respiration of the Fœtus.

Does the fœtus respire? Long a moot question, it is to-day decided that it does. There is, it is true, as Longet says, no respiration in the sense of adult respiration; but the interchange of gas, that takes place in the thickness of the placenta between the mother and child, constitutes a respiration as perfect as that of the full-grown being.

Zweifel has shown that this idea of fœtal respiration is indicated in the hippocratic books;—but that authorities were divided into two camps, one of which considered the placenta to be a real fœtal lung, and the other claiming a pulmonary respiration like the bronchial respiration for the fœtus, it being supposed to receive its supply of air from the liquor amnii. The discovery of oxygen by Lavoisier, and the realization of its important rôle in respiration, seemed to throw light upon the question. But while Clark and Darwin proved that in the egg of the chicken during incubation the venous differed from the arterial blood in color, while Bohn in dogs and Hoboken in the human fœtus showed that the blood of the umbilical vein is bright red, and the blood of the umbilical arteries reddish purple, thus confirming the statements of Scheel in 1799, Schutz, Autenreith and Bichat declared that they had never been able to appreciate such a difference.

Müller began by accepting the theory of a fœtal respiration—though he held it to be much feebler than that of the new-born; but he soon rejected it, and, confounding respiration with nutrition, claimed that the necessary juices passed directly from the maternal vessels into the fœtal blood.

Bischoff rejected the theory of a placental respiration. The placenta he held to be a maternal organ. The fœtus had no proper animal heat—and neither had it any proper respiration.

But a reaction soon came, and Litzman, returning to the idea of a placental respiration, regarded the placenta as a true respiratory organ. The oxygen of the placenta was not consumed by that organ, but was in great part transmitted directly to the fœtus through the umbilical vein.

Schutz and Autenreith, experimenting with the fœtus of the rabbit, found its temperature, immediately after leaving the uterus, to be three degrees Réamur (39° F.) less than that of the mother, whilst Bärensprung claimed that it may be the same, or more or less so, as the temperature of the maternal passages.

Wurster, under Gusserow's direction, was able to prove that the fœtus in man possessed a proper animal heat of its own, since he found it in breech cases to be higher in the fœtal rectum than in the maternal genitals.

Schwartz considered respiration proven from the presence of urea and uric acid in the fœtal urine; while Schultz noticed that the fœtus begins to make energetic attempts at respiration, whether within or without the uterine cavity, as soon as the utero-placental circulation is interrupted.

Finally, Levallais showed that the respiratory centre is situated in the medulla oblongata, and Volkmann proved that the respiratory excitability depends upon the venousness of the blood.

Thus there occurs in the placenta an interchange of gases analogous to that which occurs in the lungs of the new-born child, and which prevents the fœtus from making inspiratory attempts. In a word, the fœtus remains apnœic because, the placenta functionating regularly, its blood never becomes venous enough to excite the special respiratory centre. The fœtal blood and the maternal blood are only separated by the walls of capillaries; they are in mediate contact. On both sides this blood is in active circulation; and since the maternal blood is always saturated with oxygen, the fœtal blood must possess an equivalent quantity. But the combustion processes are not intense enough in the fœtus to make the fœtal respiration very energetic. And from this small intensity of respiration and small expenditure of oxygen arises the marked resistance to asphyxia displayed by the fœtal organism.

Schroeder, accepting these ideas, has proved that the bodies of fœtuses that succumb to an interruption of the placental circulation, show all the signs of death by asphyxia or by drowning.

Zweifel, following in the line of Hoppe-Seyler's researches, has shown, by the spectroscope, that oxyhæmoglobin exists in the umbilical vessels of the fœtus, and that the absorption bands of oxyhæmoglobin are very distinct even in cases where the cord had been tied during delivery and before the first fœtal respiration. Since, therefore, before delivery the only possible contact with oxygen is at the placenta in the maternal blood, Zweifel has given direct proof of the passage of oxygen from the maternal to the fœtal blood, and through the epithelium of the chorionic villi.

Zweifel then began a series of experiments upon pregnant rabbits, which were tracheotomised, and provided with a canula and means of artificial respiration. After anæsthetization, laparatomy was done and the uterus opened, while the entire body of the animal was submerged in a $\frac{7}{1000}$ saline solution kept at an even temperature of 38°. He found, in every case, that asphyxia upon the part of the mother caused the blood in the umbilical vein to become as dark as that in the arteries, and that the fœtus then made attempts at inspiration. On doing artificial respiration to the mother the vein regained its normal color, and the fœtal respiratory attempts ceased. Zweifel therefore concluded that the fœtus respires through the placenta, and that this placental respiration is subject to the same conditions as is the respiration of the child after birth.

Thus the fœtus, by means of the placenta, absorbs oxygen and gives up carbonic acid. But, contained as it is within the body of the mother, it is not exposed like the infant to any considerable loss of heat, and hence needs very much less oxygen.

A fact that proves how little oxygen is really necessary for the fœtus, is its resistance to asphyxia, which we mentioned above, and which, as Tarnier and Chantreuil remark, varies with the individual and probably with certain conditions still unknown to us. "Thus, when the mother dies of simple asphyxia, the fœtus dies easily, not only because the fœtal blood does not receive the oxygen from the maternal blood, but because the latter takes from the fœtal blood the oxygen that does not come to it by the respiratory passages. The rapidity of the death of the fœtus depends therefore on the rapidity with which it gives up its oxygen to the mother, and this depends probably upon the composition of the maternal blood. If, for example, the mother has been asphyxiated by the fumes of charcoal, her blood will contain an amount of carbon dioxide which will render her blood globules unfit for the absorption of oxygen; and the maternal blood will take so little oxygen away from the fœtal blood, that the death of the fœtus will take place very slowly. Such, at least, would appear to be the conclusions to be drawn from the curious experiments of Andreas Högyes and Zunz." (Tarnier and Chantreuil).

CIRCULATION.

The successive modifications through which the embryo passes may be characterized by three successive stages.

A first stage, marked by the development of the blastoderm and the existence of the umbilical vesicle. A second stage in which the allantois and umbilical vessels appear and develope. And a third stage—after expulsion, characterized by the development of the lungs and the organs of social life.

These three stages correspond to three successive circulations. The first is the stage of the blastodermic or umbilical circulation. The second is the stage of the allantoid or placental circulation. The third is the stage of the pulmonary or definitive circulation.

We will follow Kölliker in our description of the development of the heart and vessels.

First Circulation.—The first trace of blood and vessels is visible, as we have seen, a few hours after the appearance of the primitive line, and the formation of the first circulatory apparatus occurs at the same time at the centre and at the circumference, in the embryo and in the blastoderm, at the heart, capillaries, veins and arteries. That is to say, that, while the terminal sinus is being developed at the periphery of the vascular area, the heart is being formed at the centre, and between the heart and the terminal sinus there appear the capillaries, arteries and veins. Then the heart begins to beat, the *punctum saliens* of Aristotle: it is then only a simple tube, terminating at each end in two branches.

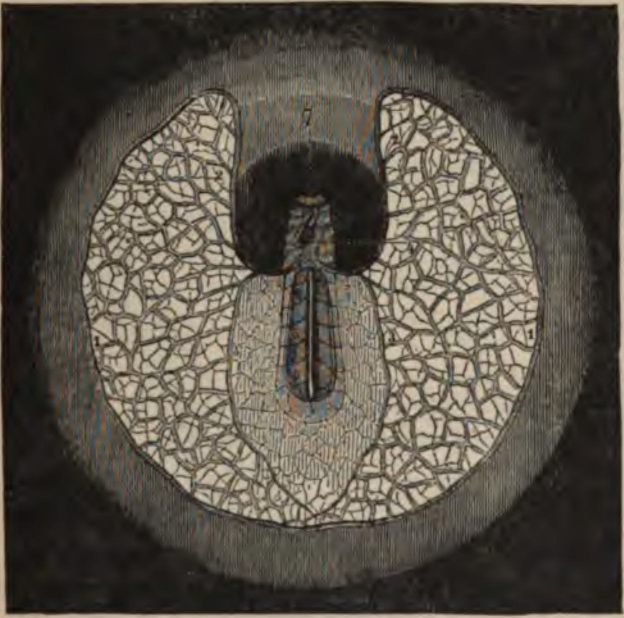


FIG. 171.—FIRST CIRCULATION.—Germinal area of the embryo of a rabbit; the embryo is seen on the ventral surface. 1, Terminal sinus. 2, Omphalo-mesenteric vein. 3, Posterior branch of same. 4, Heart, already curved into an S. shape. 5, Primitive aortæ or posterior vertebral arteries. 6, Omphalo-mesenteric arteries. 7, Primitive optic lobes. (After *Bischoff*).

The superior branches are the two first aortic arches, the inferior are the omphalo-mesenteric veins. The blood runs through the two aortas, passes into the body of the embryo, and thence goes to the omphalo-mesenteric or vitelline arteries, which carry it to the vascular area. Thence it goes into the terminal sinus, and so into the branches of the omphalo-mesenteric or vitelline veins, which conduct it back to the heart. Such is the first circulation. (V. Fig. 171.)

Second Circulation.—The appearance of the allantois and the umbilical vessels, with the development of the placenta, completely change these circulatory conditions, and determine the second circulation.

The contracting heart sends the blood from the left ventricle into the aorta, and from the right ventricle into the pulmonary artery. In the aorta the blood then divides into two streams; one, the larger, is directed towards the head and arms by the brachio-cephalic trunk of the vessel, with the left primitive carotid, and the left sub-clavicular artery. The other stream passes into the descending aorta, and fills all the branches that arise from it, carrying blood to the organs of the trunk, the lower limbs, and the placenta. But this aortic blood is not pure, since it is mixed with blood from the right ventricle. The right ventricle does

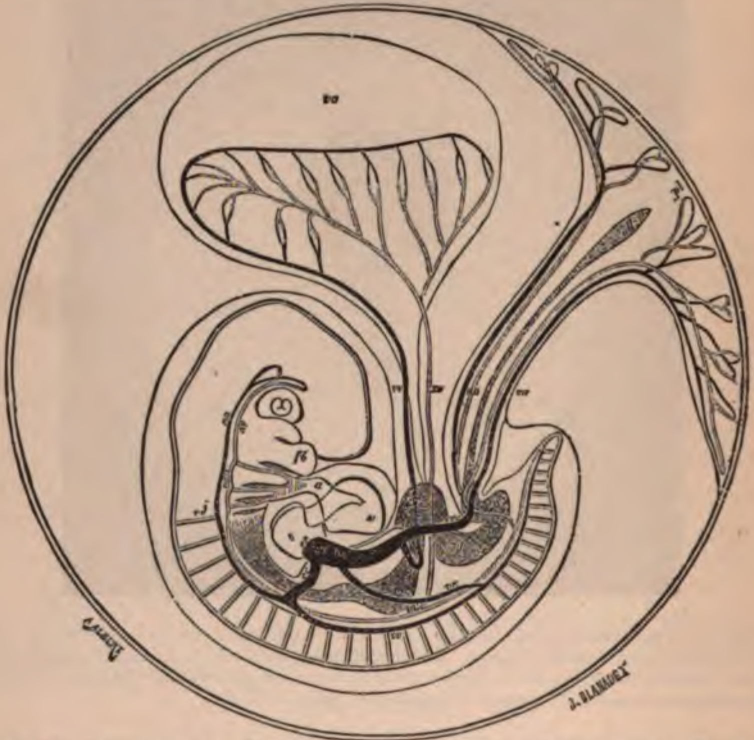


FIG. 172.—CIRCULATION OF THE FŒTUS AT THE TIME WHEN THE UMBILICAL VESICLE AND THE ALLANTOIS ARE BOTH PRESENT.—*O*, Auricles. *V*, Ventricle. *A*, Aorta. *A.V*, Right vertebral artery, having for its roots the aortic arches of the same side, and going one part to the cephalic and the other to the caudal extremity, where the omphalo-mesenteric artery, *A.V*, arises from it, as does also the umbilical artery, *A.O*. *V.O*, Umbilical vesicle. *pl*, Placenta forming. *V.O*, Umbilical vein. *V.V*, Right superior and inferior vertebral vein. *V.C*, Vena cava inferior. *AZ*, Azygos. *C.C*, Canal of Cuvier. (*Coste.*)

indeed direct the blood to the pulmonary artery, but the lungs are not functionating, and but a small portion of the blood of the right ventricle goes into them. The larger portion of it goes through the ductus arteriosus into the aorta. The aortic blood is thus a mixture of the blood of the left and of the right ventricle, of arterial and venous blood; and it is this mixed blood that goes through the umbilical arteries to the placenta. There the blood receives the oxygen necessary for the fœtal respiration, and is collected again into the umbilical vein. The umbilical vein brings the blood back to the embryo, where it divides into two currents. One, the larger, goes through the ductus venosus into the inferior vena cava, while the smaller one goes to the liver and joins the divisions of the portal vein. Thus brought to the liver, the blood returns to the inferior vena cava by the hepatic veins. The inferior cava thus receives the blood from the lower limbs, the kidneys, and the pelvic organs as well as the blood of the umbilical vein and of the vena porta; it then goes to the right auricle, but a portion only passes thence into the ventricle; the major part goes through the open ductus Botalli into the left auricle, thence to the left ventricle, and meantime the blood that has gone through the brachiocephalic, the left primitive carotid and the left subclavicular arteries, is gathered again into the superior vena cava, and, goingto the right auricle, passes into the right ventricle, and thence through the pulmonary artery and ductus arteriosus again into the aorta. Thus no part of the fœtus receives absolutely pure blood. (V. Fig. 172.)

Third Circulation.—As soon as the fœtus has made its first inspiration, the third circulation, the pulmonary or definitive circulation, is established.

The umbilical vein, its function gone, is obliterated, and becomes the round ligament of the liver; the umbilical arteries and the ductus venosus also atrophy. The ductus Botalli disappears, as does the ductus arteriosus, after persisting for one or two days. The pulmonary circulation replaces the placental circulation.

The two auricles no longer communicate, and the entire blood of the pulmonary artery passes into the lungs. There it becomes oxygenated, and is returned by the pulmonary veins to the left side of the heart and so to the systemic circulation. Thus, in its turn, the third circulation is established. (V. Fig. 173)

SECRETIONS.

The secretory organs of the fœtus are: The skin, the sebaceous glands of which secrete the vernix caseosa. The intestinal mucous membrane, at first secreting only simple mucus, at last, with the secretions of liver and pancreas, forming the meconium. The cephalo-rachidian serous membrane, which furnishes the cephalo-rachidian fluid. Finally, the kidneys, which secrete the urine. All agree that urine is secreted; but is it excreted?—Does the fœtus void it into the liquor amnii? On the one side we have the distension of the bladder at birth in cases of obliteration of the urethra, the presence of urea in the amniotic fluid, and the constant relation between the amount of urea secreted during the last three months of pregnancy and the weight of the fœtus (see Liquor Amnii, Prochownik). On the other hand, we note that in every case where there has been retention of urine, there is a vice of conformation; that the quantity of the liquor amnii bears no relation to the weight of the fœtus; and finally that the amount of urea in the liquor amnii is not always proportionate to the weight of the fœtus (dropsy of the amnion). In fact the question is one that cannot at present be decided.

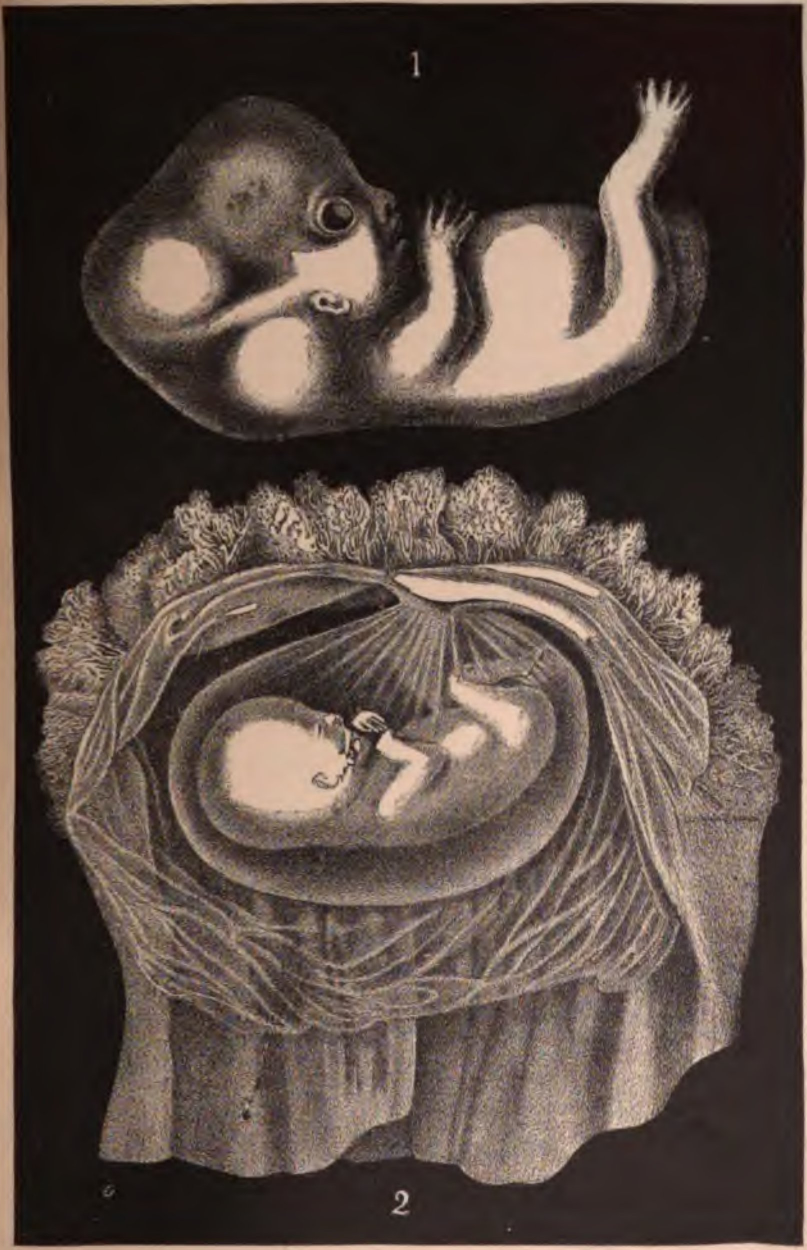
INNERVATION.

That the fœtus possesses nerves is proven by abdominal palpation, which enables us to perceive frequent and spontaneous fœtal movements. Jacquemier has proved *de visu* the excitability of the nervous system of the fœtus, by opening the womb of a pregnant rabbit and seizing with a pair of forceps the paw of a fœtus. The fœtus forthwith showed signs of agitation. Pinard, however, has not found this conclusive; he regards the movements as being simply reflex.

Such are the functions of the fœtus; but while they suffice to permit it to develop to full term, they are not necessarily sufficient to allow it at any period to begin an extra-uterine life. A certain amount of development of its organs is necessary. For though the law fixes the period of viability at six months, obstetricians place it at seven. The weight of the fœtus has nothing to do with it, for very small infants have survived. We ourselves have seen one live that only weighed 2.09 pounds. It was born one week before the beginning of the seventh month, counting from the last menstruation. It is now a girl two years old, of average weight and development. On the other hand, we have had occasion to see another child, also a girl, born at term, and weighing then two and one-half pounds, which now, at fourteen months, weighs only fourteen pounds. She has eight teeth, can walk alone, and is beginning to talk. These cases, however, are entirely exceptional.

ATTITUDE AND POSITION OF THE FŒTUS.

By attitude of the fœtus we understand the relations of the different parts of the fœtus to each other and to the uterus. Enclosed in a cavity of limited extent, the fœtus is so placed as to occupy the least possible space. It is, as it were, folded upon itself. The trunk is flexed, the chin touches the sternum, the upper limbs are crossed upon the chest, the lower ones crossed and folded upon themselves, so that the thighs are flexed upon the pelvis, the legs flexed upon the thighs, and the heels applied to the buttocks. In the free space between the upper and lower limbs the cord is placed. The entire fœtus is in the attitude of flexion,



THE FETUS ENCLOSED IN ITS MEMBRANES

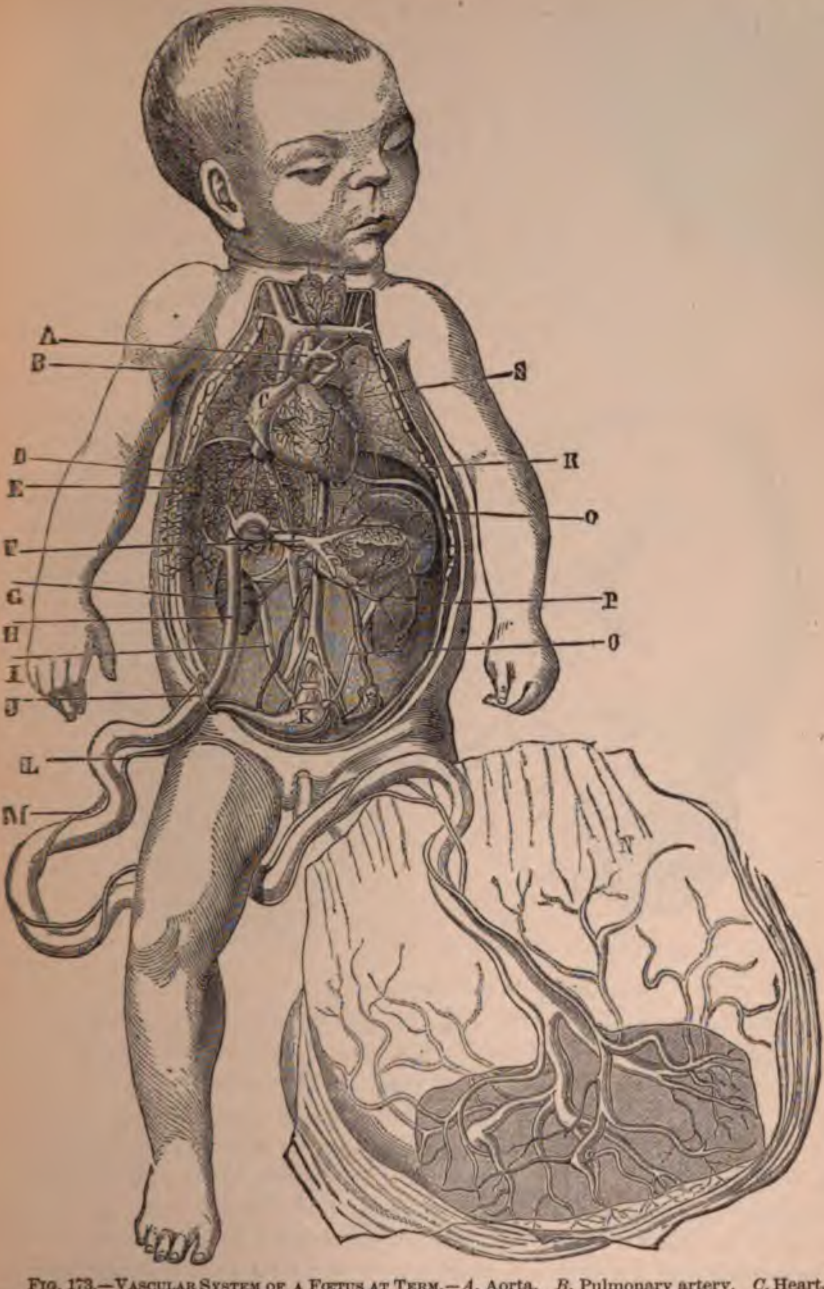


FIG. 173.—VASCULAR SYSTEM OF A FŒTUS AT TERM.—*A*, Aorta. *B*, Pulmonary artery. *C*, Heart. *D*, Termination of the umbilical vein in the sub-hepatic veins. *E*, Inferior vena cava. *F*, Portal vein. *G*, Right kidney. *H*, Umbilical vein. *I*, Right ureter. *J*, Umbilicus. *K*, Bladder. *L*, Left umbilical artery. *M*, Right umbilical artery. *N*, Placenta. *O*. Left ureter. *P*, Left kidney. *Q*, Spleen. *R*, Right half of diaphragm. *S*, Left phrenic nerve. (*Martin Saint Ange.*)

and forms an ovoid, the large end of which is formed by the pelvic extremity, and the smaller by the cephalic end.

This attitude is in large measure due to the pressure of the walls of the uterine cavity upon the fœtus; but we cannot admit, with Martel and Pinard, that the flexed attitude is due to causes solely material and extrinsic. Without accepting the theory of instinctive reason on the part of the fœtus (Dubois), or the action of vital causes (Simpson), we must not forget that flexion is one of the first phenomena of embryonal development. From the very first day the embryo tends to incurvation. This primal curvature seems to continue to the end of pregnancy, and is, we think, largely responsible for the attitude of the fœtus in the uterine cavity. (Fig. 174.)

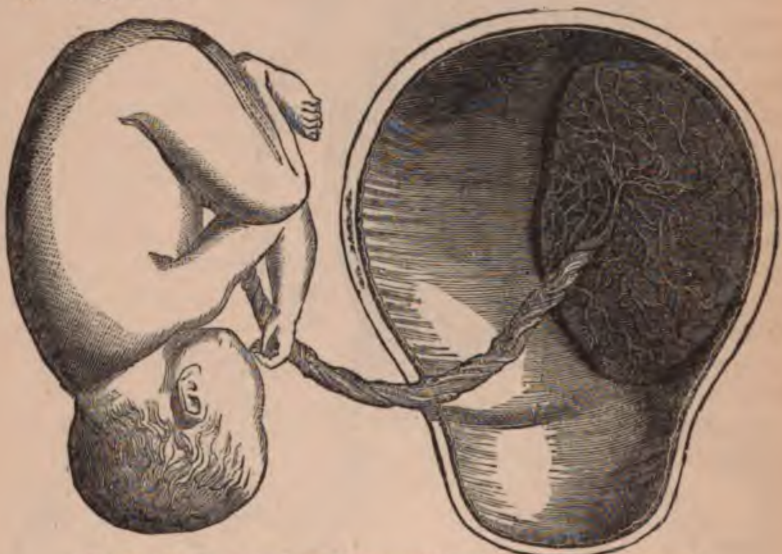


FIG. 174.—ATTITUDE OF FŒTUS, INSERTION OF PLACENTA. (After *Schultze*.)

The cephalic extremity is usually lowest in the uterus, and in pregnancies that go to full term. The head is usually the presenting part, though this is not so frequently the case in premature births. Accoucheurs have sought to explain this fact by various theories. The most ancient is that of Hippocrates, which supposed that the fœtus was originally head uppermost in the uterus, where it was held by bands proceeding from the umbilicus. At the end of the seventh month, the legal time of labor, these bands broke, and the fœtus, from its own weight, turned a somersault, and so placed itself head downward. At the moment of delivery the child emerged by its own efforts, its feet being braced against the fundus uteri. Hence the difficulty of delivering dead infants.

Aristotle insisted upon the correctness of this theory, and showed that the part of the body above the umbilicus is more voluminous than that below it; hence the head must tend to fall towards the uterine orifice.

Realdus Colombus recognized three presentations: 1st, and most frequently, by the head; 2d, by the pelvic extremity; 3d, and least common, by the trunk.

Jean Fernel adopted the theory of Hippocrates, and believed that the fœtus tore the membranes with its hands and feet.

Ambroise Paré claimed that the fœtus instinctively placed itself head downward, since delivery is most easy in that position.

Lamotte, Smellie, Solayres de Renhac, and, especially, Baudelocque, combated the somersault theory and finally overthrew it.

Baudelocque showed by autopsies that the head could occupy the inferior segment of the uterus before the seventh month. Then, calling attention to the minuteness of the fœtus during the first months, as compared with the size of the uterus and the amount of the liquor amnii, and its necessary mobility, to the anterior flexion of the fœtus, and to the weight of the cephalic extremity in comparison with the rest of the body, he claimed that it was impossible to believe that the fœtus remained motionless for months at a time in the inferior segment of the womb. The uterus at term forms an ovoid, the larger end of which is uppermost. The head fits itself into the lower and more pointed extremity, the buttocks and legs lie in the larger end, and the fœtus has assumed its normal position. The somersault, he claimed, could not take place at the seventh month, since the length of the fœtus is greater than the diameter of the uterus.

Bichat called attention to the agility and mobility of the fœtus, and to its suspension by the cord. He admits that it is not until it is to a certain extent developed that it is definitely fixed head downward.

Termanini, Kilian, Schmidt, Carus, Ritgen and Stein, regarded the point of placental insertion as the determining point in the position of the fœtus.

Paul Dubois, in a series of celebrated experiments with fœtuses of four to nine months, proved that the centre of gravity is not situated in the head, but at a point in the trunk near it. He returned to the theory of Ambroise Paré. "The fœtus by instinctive or voluntary determination makes certain movements, until it finds the position most favorable for its sojourn in the uterus, and for delivery."

Veit, repeating Paul Dubois's experiments, arrived at a different conclusion, and together with Batthlener, Matthews Duncan and Schroeder, returned to the somersault theory.

Simpson offers the following objections to it:

1st. The vertical position that the theory assumes is not constant.

2d. The infant cannot be regarded as suspended from the umbilical cord, for it is too long, and too frequently twisted. The placental site at the fundus, also, is very variable.

3d. Hydrocephalic fœtuses rarely present by the head; acephalic fœtuses frequently do so.

4th. In still or premature births (up to the seventh month), presentation of the inferior extremity is relatively frequent. He regards the muscular movements of the fœtus as the cause of vertex presentation, but claims that they are purely reflex motions and not due to instinct or volition. The uterus, rounded up to the sixth month of pregnancy, becomes thereafter oval, with its smaller extremity directed downwards. The fœtus in the same way forms an ovoid, the larger end of which, placed at the fundus, consists of the breech with the inferior extremities. In any other position it presses upon the uterine walls, which in their turn react and provoke reflex fœtal movements, which persist until a vertex presentation is attained.

Though denied by Ritgen, Wölckler, Cazeaux, and Jacquemier accepted this theory.

Gauriet, Credé, Kristeller regard the uterine contractions occurring during pregnancy as the cause of the cephalic presentation.

Scanzoni admits all the suggested causes: the effect of specific gravity, the influence of the shape of the uterine cavity, of the form of the fœtus, of the quantity of the liquor amnii, and even the active movements of the fœtus.

Cohnstein believes that the different conditions of the fœtal circulation, during the first six months and after that time, will explain the relative frequency of vertex presentations. Until the sixth month, the superior half of the fœtus receives more blood than the inferior half; the latter is heavy from the increased vascular tension, and hence frequently presents. But at the seventh month an inversion occurs, so that the lungs, which are not functionating, and which are not therefore subject to their subsequent pressure, may receive the increased blood pressure ! ! !

As we see, there are explanations enough; unfortunately there are numerous objections to each. It is to Pajot that the merit belongs of having first formulated the law of fœtal accommodation, which is as follows:

"When one solid body is contained in another, and if the latter is alternately in a state of motion and of repose, and if the surfaces are rounded and smooth, the included body constantly tends to accommodate its shape and dimensions to the shape and capacity of the containing body."

This law, which we accept in its integrity for pregnancy as well as for delivery, is only admitted as active by Tarnier and Chantreuil during delivery. They return to the theory of Dubois and of Simpson, without deciding whether the movements are instinctive or reflex. The fœtus is pressed upon by the uterine walls, they say, seeks the most convenient position, and adopts an ovoid shape to correspond to that of the uterus. The following positions may be assumed:

1. The narrow transverse diameter of the uterus hinders trunk presentations; hence the fœtal ovoid tends to place itself vertically, either by its own movements, or in consequence of uterine pressure.

2. At the fifth and sixth months of pregnancy the pelvic extremity, with the limbs, is no larger in volume than the head; hence either end of the fœtal ovoid may occupy the inferior segment of the uterus, and breech presentations are as common as those of the vertex.

3. Toward the close of pregnancy, the development of the buttocks and the lower limbs is such that the pelvic becomes larger than the cephalic extremity, and the fœtus changes its position, and remains head downward. Hence the frequency of vertex presentations at term.

4. These changes explain the active movements made by the fœtus during pregnancy.

"This position of the infant," says Bailly, "is the mechanical result of the shapes of the contained body and of its envelope, and is doubtless accomplished by the contractions of the uterus and the shaking of the fœtus by the motions of the mother."

Pinard says: "It is now universally admitted that in the first six months of pregnancy the fundus, or superior segment of the uterus, is more developed than the inferior segment, and that the head is at that time the largest part of the fœtus. During the entire period of pregnancy painless uterine contractions occur; and it is proven that, when the uterus contracts, it diminishes its transverse and increases its longitudinal diameters, and as no woman remains motionless during gestation, the movements of the mother must react more or less upon the fœtus."

Martel goes still further: "The accommodation," he says, "must have been difficult; there must have been some special obstacle, when the vertex does not come in contact with the superior strait." He believes that, at the end of gestation, the fœtus becomes much less mobile, and remains in the position given it by the contractile sac in which it is lodged. He finds the cause of the folding of the fœtal body, and of its fixation, in the diminution of the amount of liquor amnii as compared with the volume of the fœtus.

Statistics all confirm the law of accommodation as stated by Pajot. Pinard, who, like all French accoucheurs, admits this law, regards the abdominal wall as the main factor rather than that of the uterus. While we do not deny that the contraction of the abdominal parietes does have a certain influence, it must be much inferior to the contractions of the uterine muscle itself. For Herrgott has demonstrated that the shape of the uterus has great influence upon the presentation, and that shape does certainly not depend exclusively upon the support offered to the organ by the abdominal parieties. There are certainly other elements in the question, though Pinard makes light of them. Wombs vary in thickness and in tonicity, especially after repeated childbirths. For if we find in multiparæ a larger proportion of presentations other than vertex than we do in primiparæ, it is not only because the abdominal walls are flat and relaxed, but because the uterus has lost its tonicity and resisting power. Is it likely that the abdominal wall, so thin in certain women, and separated from the fœtus by both uterus and liquor amnii, should have a greater action on the fœtus than the walls of the womb? As Martel says, how can we admit that relaxation of the abdominal wall will in any way affect the interior of the uterus, unless there is also relaxation of the uterine wall itself. The uterus might fall forward, but the change would be merely one of position; the organ would still preserve the shape of an ovoid, with the smaller extremity directed downwards.

If, in primiparæ, the head engages more often than in multiparæ, it is not because, as Pinard says, the inferior segment of the uterus, the uterine diaphragm as he calls it, descends with the head into the pelvic cavity in the one case, and in the other case remains above it. No! The inferior segment of the uterus descends as much in the one case as in the other. If the head engages in primiparæ, while it does not do so in multiparæ, it is because the laxity of the abdominal walls in the latter renders the accommodation of fœtus to uterus less complete and less intimate.

This can be proved by ordinary observation. When primiparæ arrive at the end of their pregnancy, we find the head engaged and intimately applied to the inferior segment of the uterus, which is so thinned by the pressure of the head, and so moulded over it, that we can feel the sutures and fontanelles distinctly through it, and if we attempt to displace the head, we will displace the uterus together with it. In multiparæ, on the contrary, the contact is never so intimate; the head is always, even when engaged, a certain distance above the inferior segment; it is relatively mobile and can be lifted, and we can feel it recede before the finger and leave the inferior segment of the uterus. The head may be engaged, the presentation does not change; but the moulding of the uterine parietes to the head is less intimate, and the accommodation is less perfect. According to our ideas the abdominal wall plays but a secondary part in the process.

How, unless we take into account the peculiar shape of the uterus, and the special elasticity of its walls, can we account for those cases in which we see women in successive pregnancies, from the first to the last, have a series of breech or trunk presentations?

We therefore entirely agree with the following conclusions which Martel has enunciated in his thesis:

"If engagement occurs earlier in primiparæ, it is because of the greater rigidity of the uterine parietes, which keeps the fœtal ovoid rigidly in the uterine axis. There is thus a tendency to the projection of the inferior part of the uterine ovoid into that part of the pelvic cavity sufficiently open to receive it. This downward progression is greatly favored by the flexion of the head, which is marked in most cases, though not complete, at the superior strait. Thus the head presents its smallest diameter at the superior strait, and passes through it prematurely.

"In multiparæ, on the other hand, the uterine parietes are more distensible, the cavity is larger, the fœtus is more mobile, and consequently the pressure is not exerted perpendicularly to the axis of the superior strait, but to a point behind the pelvis, or towards the abdominal walls, or even to the symphysis pubis. Therefore engagement does not so readily take place."

PRESENTATIONS OF THE FŒTUS.

Cephalic Presentation with Flexion of the Head.

Although the presentation has been regarded by almost all accoucheurs as a part of the mechanism of labor, Tarnier and Chantreuil rightly claim that it should be considered in the section on Pregnancy; for, they say, it is always of the very greatest importance to recognize the presentation during pregnancy, since it enables us to transform vicious or defective presentations into favorable ones. Let us first define what we understand by presentation and by position.

In the earliest times, authors claimed that the fœtus could present at the superior strait by any point of its surface, so that the number of presentations and positions admitted by them was infinite. To Solayres de Renhac belongs the credit of having first attempted a classification. He was followed by Baudelocque, Gardien, Capuron, Maygrier, Dugès; but it is to Mme. Lachapelle that we owe the first exact definition of the words presentation and position.

To have a presentation, it is necessary that the part that tends to engage at the superior strait be voluminous enough to almost completely fill the passage.

By position of the fœtus we understand the relation of this presenting part to certain fixed points of the pelvis.

Madame Lachapelle first showed that the fœtus always presents itself either by the cephalic extremity, or by the pelvic extremity, or by the trunk.

The cephalic extremity may be flexed, presentation of the vertex; or it may be extended, presentation of the face.

The pelvic extremity may be completely flexed, the inferior members being closely applied to the nates, complete presentation. It may not be completely flexed, and then becomes one of three varieties: either the thighs and legs are extended along the anterior surface of the fœtus, breech presentation; or the thighs are extended upon the pelvis and the legs flexed upon the thighs, knee presentation; or both legs and thighs are extended, foot presentation.

The trunk presents always by one of its sides, left or right, but it is the shoulder that occupies the superior strait. We have therefore a presentation of the right shoulder, and a presentation of the left shoulder.

Adapted by Naegelé, Dubois, Stolz and all the modern accoucheurs, this classification is the one universally accepted to-day. Only, since the knee presentation is exceedingly rare, and since the mechanism of delivery is the same, whatever be the presentation, their number has been still further simplified, and we admit only three presentations, each one of which has two varieties.

1. Presentation of the cephalic extremity: head flexed, vertex: head extended, face.

2. Presentation of the pelvic extremity: complete, breech: incomplete, foot.

3. Presentation of the trunk: right lateral plane, right shoulder: left lateral plane, left shoulder.

These presentations each represent one of the main parts of the fœtus, and if the parts descend vertically into the centre of the pelvis they are called clear or regular presentations. If, however, they are more or less inclined to the plane of the superior strait, they are called irregular or inclined presentations.

Inclination of the presentation will, of course, give us some varieties of the part occupying the centre of the superior strait; thus, for the vertex, we have frontal, occipital and parietal varieties; for the breech, pubic, sacral and iliac varieties; for the trunk, cervical, abdominal and costal varieties. But these irregular positions usually become regular during the course of labor. We will study them in detail when we come to describe the mechanism of labor. At term, as all statistics prove, vertex presentation is the rule. We will only give the figures of Dubois, of Mme. Boivin, and of Depaul. Dubois, in 2020 deliveries at term, found 1913 vertex presentations. Mme. Boivin, in 20,517 births, found 19,810 vertex presentations. It is not so in premature births. Thus in 165 dead fœtuses, born before the sixth month, Dubois and Scanzoni found:

Presentation of the cephalic extremity	81
“ “ breech and feet	80
“ “ trunk	4
	165

In 1231 births between the sixth and eighth months, Veit found:

Presentation of the vertex. . . .	898 (62.88 per cent.).
“ ‘ breech . .	243 (16.32 “).
“ . “ shoulder . .	50 (3.5 “).
	1231

Depaul recorded, in 16,233 accouchments, 15,119 vertex presentations.

Vertex Presentations, with Extension of the Head.

Although formerly considered so dangerous as always to require active interference, face presentations were regarded by Mme. Lachapelle not only as harmless, but almost more favorable than presentations of the vertex. This is far from being the case, and, without going as far as did the older authors, it can safely be said that the presentation is a troublesome one for both mother and child. It is the rarest of all the presentations: thus in 15,652 births, Mme. Lachapelle only found it 72 times, and in 81,711 births, Pinard only found it 330 times.

In 7835 births at Vienna	Nægelé	found it 44 times.
" 8514 " " Prague	and	" 58 "
" 7104 " " Göttingen	Grenser	" 39 "

" 16232 births Depaul found it only 93 times.

" 8212 births at Munich, Hecker found 49 face and 7 forehead presentations.

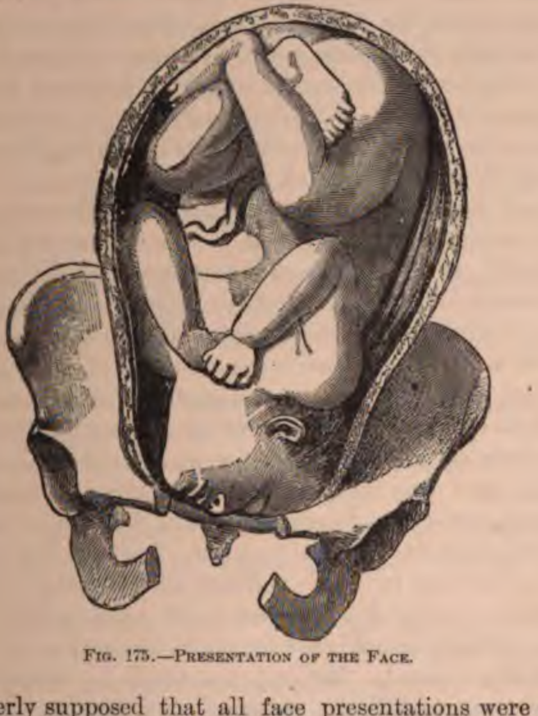


FIG. 175.—PRESENTATION OF THE FACE.

It was formerly supposed that all face presentations were secondary, that they were only transformations of vertex presentations that occurred during delivery.

Mme. Lachapelle was the first to prove that there was such a thing as a primitive face presentation, existing as such before labor began at all. Her observations have been confirmed by those of Nægelé, of Depaul, and of Spiegelberg. Nevertheless, secondary presentations of this kind are much the more frequent.

Many different causes have been invoked to explain face presentations. We must refer the curious reader to the works of Hecker and Buhl, of Freund, of Ahlfeld, and of Winckel. The latter has enumerated not less than thirty-three different ones.

It was long believed that uterine obliquity was the cause of face presentations. First proposed by Deventer, this explanation was accepted by Baudelocque, Michælis, Mme. Lachapelle, Winckel, and Matthews Duncan.

The latter says that, in ordinary labor, where the vertex presents, whether the occiput be directed to the right or to the left, the change to a face presentation is prevented by the greater length of the arm of the anterior lever of the head. Pressure from above, when the longitudinal axis of the uterus coincides with the axis of the superior strait, causes flexion of the head. But when the posterior arm of the lever is the longest, extension of the head, and a forehead presentation results, the first step towards a face presentation. The part of the pelvis where this occurs has a rectilinear axis, except where there exists a slight inclination of the uterus to the right. This frequent right inclination of the uterus determines, at the level of the superior strait, a curve of the genital canal, the concavity of which is directed to the right side.

In the great majority of cases of right lateral inclination of the uterus, the occiput occupies the concavity of the genital curve at the level of the superior strait. If the head encounters much resistance, the occiput tends to descend first, from the relative shortness of the arm of the posterior lever; and since it is placed nearer the concavity of the canal, it is nearer to the axis that represents the resultant of forces, an axis which, from the right lateral deviation of the uterus, runs from above downward, and from right to left. The vertex presentation will then persist. In a certain number of cases, about twice in seven times, the occiput approaches the right side of the pelvic canal, the convex side, while the forehead touches the left and concave side of the canal. The resultant of the forces will tend, of itself, to make the forehead descend. This tendency of the forehead to descend instead of the occiput will be, in most cases, successfully resisted by the soft parts, which oppose the descent of the anterior part of the head, the length of the arm of the anterior lever being much the greatest. But in a case where the lateral inclination of the uterus is exaggerated, this resistance is overcome, and the forehead descends. In cases where the head is dolicho-cephalous, the resistance of the arm of the anterior lever of the head will be diminished, and in some cases will be entirely annihilated. The forehead is then obliged to descend first, and extension will occur.

Winckel, who admits this effect of uterine obliquity, believes that face presentations are more easily produced when the back of the child is turned to the right side. He has collected 376 cases of face presentation, and has arrived at the following conclusions:

1. Face presentations occur almost as frequently in primiparæ as in multiparæ.
2. One-third of the primiparæ that have them are aged, and have passed the age of twenty-six years.
3. It is rare to see successive face presentations in the same woman, save in cases of contracted pelvis.
4. Multiparæ that have face presentations have already had faulty presentations; *i.e.*, have an abnormal shape of the uterus, or difficult labors.
5. Contractions of the pelvis are often coincident with face presentations.
6. Multiparæ, with pelvis contracted to the second and third degrees, have face presentations oftener than have primiparæ with contracted pelvis.
7. The presentation M.I.R. is to that of M.I.L. as 7 is to 5.
8. Face presentations entail longer labors than do those of the vertex.
9. They need interference oftener.
10. In fifteen per cent. of the cases the change into a face presentation occurs during labor.
11. Infants born by the face are above the average weight.
12. They are more often stillborn, thirteen to fourteen per cent. being so delivered.
13. Not unfrequently bands of the cord cause the death of the child.
14. The membranes are often prematurely ruptured.
15. Prolapse of the cord is relatively frequent, occurring in 2.25 per cent. of the cases.
16. Face presentations are equally frequent in all countries, and occur about once in 150 births.
17. The presentation of the face is never determined by a single cause, but by the union of two or three predisposing ones. The most frequent of these causes are: contractions of the pelvis, size of the infant, small quantity of liquor amnii, a pendulous abdomen, and uterine obliquity with contraction of the pelvis.

Hecker attributes face presentations to exaggerated development of the occiput. The occipital protuberance lengthens the arm of the posterior lever, so that the uterine contractions cause the occiput to recede. The head see-saws, the occiput ascends, the chin is lowered, and the face presents. Budin, however, has proved that this dolicho-cephalicism is only secondary, being caused during delivery, and that it disappears with greater or less rapidity after birth.

Schroeder believes that the occiput offers a greater resistance than does the forehead, and that the latter descends, though situated at the end of the longer lever. Fasbender lays great importance upon the volume of the fœtus, and Winckel and Pinard fix 1500 grains as the average excess of weight of face over ordinary presentations.

Finally, a number of authorities, and especially Matthews Duncan and Winckel, have called attention to the effect of faulty conformation of the pelvis. Winckel, in 400 face presentations, found eighty-seven cases of contracted pelvis. With Tarnier, Chantreuil and Pinard, we do not believe that the influence of this deformity is as great as is claimed, for other causes are usually active. Uterine obliquity is generally very marked in these cases.

Martel believes that face presentations are caused by external shock. An abrupt muscular contraction of the abdominal wall is not able to effect a complete change in the relations of the fœtus to the uterine cavity, but it can change the relation of the head to the abdominal strait when the accommodation of form and direction, for some cause, such as a pelvic contraction, cannot occur.

We believe ourselves that it is impossible to attribute face presentations to any one cause; for as Winckel has shown, the causes are often multiple. In his 376 cases he found pelvic contractions, large infants, small quantities of liquor amnii, pendulous abdomen, uterine obliquity, in fact everything that prevents the normal accommodation of the fœtus, to be the ordinary causes of face presentations. Ahlfeld has studied each of these causes separately, and has arrived at the following conclusions:

The causes of face presentations are primary in primiparæ, primary and secondary in multiparæ. Separating then, as all the German authors do, forehead presentations from those of the face, and admitting even primary and secondary forehead presentations, these causes according to him, are as follows:

1. *Face Presentation—Primary Causes—Primiparæ.—a.* Tumors of the neck and upper portions of the thorax. Congenital struma. *b.* Bands of the cord around the neck. *c.* Stricture of the uterus, the compression occurring at the region of the neck. *d.* Exaggerated development of the head and thorax as compared with the normal length of the fœtus. Increase of the total fœtal weight. *e.* Absence of neck in the fœtus. *f.* Dolicho-cephalicism, the volume of the chest being normal, or over. *g.* Shortness of the cord, which, dragging from before backwards, brings about extension of the head. *h.* Twin pregnancies, the two fœtuses lying longitudinally, or the one lying longitudinally, and the other transversely. *i.* Acrania or hemicephalia.

Primary Causes, Multiparæ.—a. An abnormal separation of the chin from the chest, first degree of extension. *b.* Excessive amount of liquor amnii, and small volume of the fœtus leading to exaggerated mobility of the head. *c.* Intra-uterine death of the fœtus. (Asphyxia, recent death, maceration). *d.* Uterine obliquity. *e.* Presentation of the lateral plane of the fœtus, and above all of the belly. *f.* Rapid outflow of the liquor amnii. *g.* Sudden changes of position in pregnant females, in oblique and ventral presentations.

Secondary Causes, Multiparæ.—Do not exist in primiparæ. *a.* Abnormal contraction of the internal os, which opposes the engagement of the neck. *b.* Uterine or peri-uterine tumors. *c.* Placenta prævia. *d.* Rigidity and tumefaction of one or both lips of the os. *e.* Obstacles formed by the linea innominata.

1st. The fœtus descends perpendicularly, the fœtal axis being parallel to the vertebral column; if, for a primary cause, there is a projecting occiput, this occiput will be arrested by the linea innominata, and it will ascend while the forehead descends. 2d. The fœtus lies obliquely with reference to the superior strait, and then occurs a presentation of the forehead or of the face, the belly looking more or less directly downwards; then either the occiput will be stopped by the innominata ridge, or the forehead will be arrested. *j.* Procidentia of an arm, more rarely of a foot. *g.* Too large or too long iliac spines; the sciatic ligaments and tuberosities; small inclination of the pelvis; all these things may arrest the occiput. *i.* Exostoses or tumors of the pelvis. *j.* Persistence of the hymen. Atresia of the vulva ! !

Hemicephalia always causes face and not forehead presentations.

2. *Forehead presentations—Primary causes*—1. Fœtal hydrothorax or ascites. 2 Exaggerated development of the thorax, or œdema of the thorax. 3. Hydrocephalus. 4. An abnormally short neck. 5. Tumors of the neck, congenital struma, bands of the cord around the neck or forehead. 6. A fœtus before term, feeble, or macerated, the increased weight of the head not being compensated by muscular action.

Secondary Causes.—1. Interference with descent of the occiput, the uterine pressure working upon the other arm of the lever. 2. Contractions of the pelvis; in some relatively frequent cases, resistance of the os.

Presentation of the Pelvic Extremity.

The pelvic is the most frequent presentation after that of the vertex.

Mme. Boivin, in 20,517 births found it	. .	611 times
" Lachapelle, in 37,895 births found it .	.	1390 times
Dubois " 2,022 " "	. .	85 "
Depaul " 16,233 " "	. .	633 "
Hecker " 3,472 " "	. .	99 "
Pinard " 100,000 " "	. .	3301 "

Mme. Boivin, in her 611 pelvic presentations, encountered:

Nates	373 times
Feet	234 "
Knees	4 "

We have seen that the presentation of the vertex results from the perfect accommodation of the fœtus to the uterine cavity, which does not take place until the sixth or seventh month. Indeed, until then, the amount of liquor amnii leaves the fœtus very mobile; so that the fœtus may find itself, as it were, surprised and fixed in a sitting position, without being able to return to a vertex presentation, in consequence of uterine resistance or contractions. We may mention, among the things that increase fœtal mobility and breech presentations, a special conformation of the uterus, multiparity, premature labor, smallness of the fœtus, death of the fœtus, contractions of the pelvis, tumors of the uterus, vicious insertion of the placenta, hydramnion, hydrocephalus, twin pregnancies, mobility of the limbs, and finally, premature rupture of the membranes, which may render the presentation incomplete.

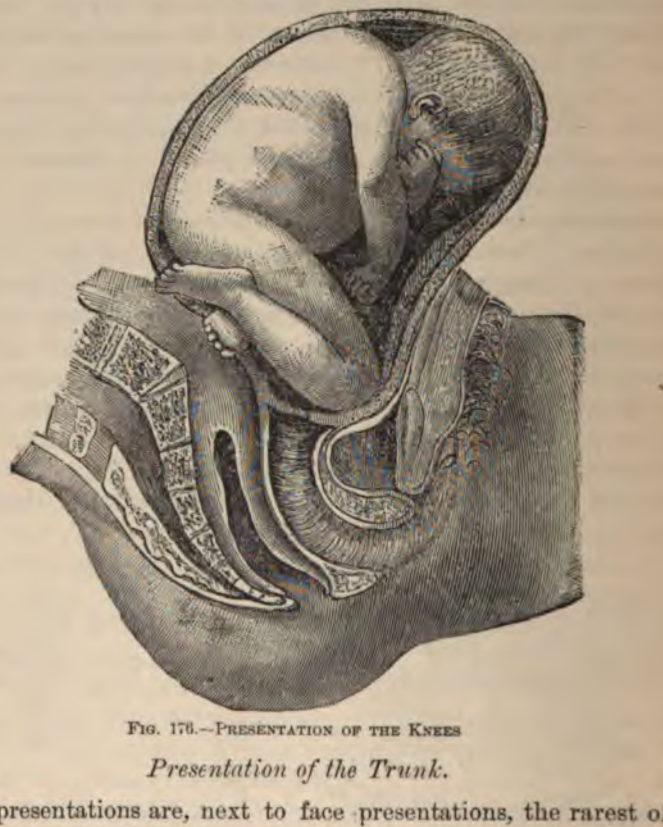


FIG. 176.—PRESENTATION OF THE KNEES

Presentation of the Trunk.

Trunk presentations are, next to face presentations, the rarest of all. Thus:

Mme. Lachapelle,	in 15,652 births, had it . .	68 times
P. Dubois	“ 2,022 “ “ . .	13 “
Pinard	“ 100,000 “ “ . .	804 “

According to Depaul, the right shoulder presents a little oftener than the left; as 76:69. When the fœtus presents by the trunk, the presentation is never exactly transverse; one end, usually the breech, is the more elevated. The child always lies more or less obliquely, and it is not, as Tarnier and Chantreuil say, only during labor and under the influence of uterine contractions that trunk presentations occur. Transverse presentations can happily be detected before labor sets in, thus enabling us to transform them into vertex cases (except where there are twins) by means of external version.

The causes of trunk presentations are many, and, besides the peculiar shape of the uterus to which Herrgott has called attention, multiparity, relaxation of the uterine and abdominal walls, uterine obliquity may be mentioned. We may also note pelvic contractions and fibromata, a vicious insertion of the placenta, small size of the fœtus, death of the fœtus, premature births, dropsy of the amnion, twin pregnancy—in a word, all the things that hinder a normal accommodation.

Positions of the Fœtus.

By position we understand the relations of the presenting part to different points in the pelvis.

It is therefore necessary to settle upon certain fixed points, both upon the pelvis and upon the fœtus, for each presentation. Authorities have always been practically in accord so far as the points upon the fœtal body are concerned. The occiput has been taken as the type of vertex presentations, and the forehead or chin as that of the face. We ourselves prefer the chin, for it is the part that ought, like the occiput to revolve under the symphysis to complete delivery.

For the pelvic extremity, complete or incomplete, the sacrum is selected; for the knees, the anterior surface of the tibia; and for the feet, the calcaneum. For the trunk, since the shoulder commonly presents at the superior strait, the acromion is the characteristic sign. We think, indeed, that the axillary depression forms a landmark more easily recognizable. The thoracic wall that forms one side of the crease, is composed of the hard ribs and the soft intercostal spaces, which give to the finger the special sensation which has led Pajot to speak of it as the intercostal gridiron. No other part of the fœtus gives this sensation. It is true that, when the dorsal region presents, the ribs are a little more difficult to reach, and the finger impinges instead upon the scapula and its spine. But it is always possible, by carrying the finger backwards, to reach the thoracic wall, and so obtain a sensation that is typical. The apex of the axilla, being directed upwards, always gives the explorer the position of the head. The acromion process is not sufficiently characteristic, and since it is sometimes the elbow that we encounter, it is better to have a more exact landmark. For whether the side or shoulder presents, the ribs

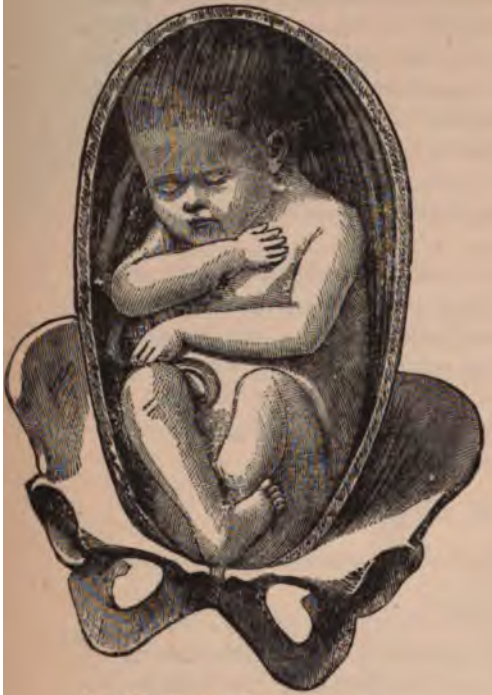


FIG. 177.—BREECH PRESENTATION.

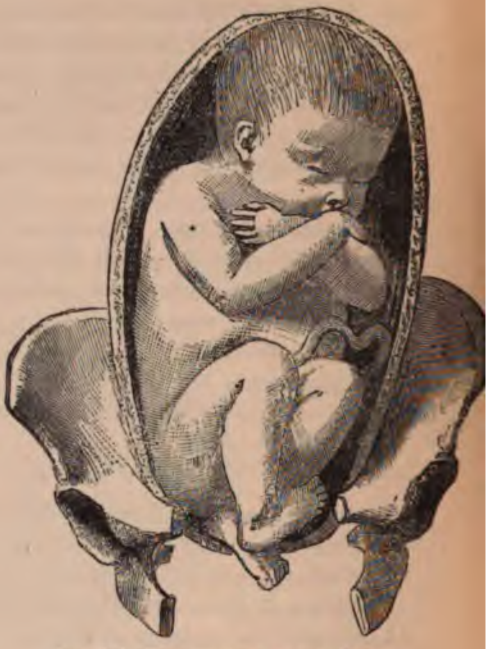


FIG. 178.—PRESENTATION OF THE FEET.

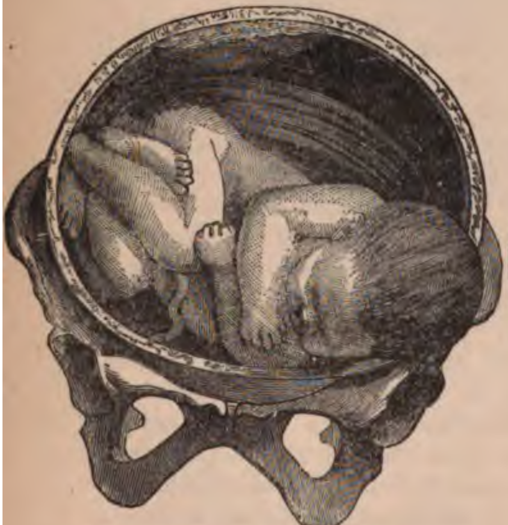


FIG. 179.—PRESENTATION OF THE SHOULDER.

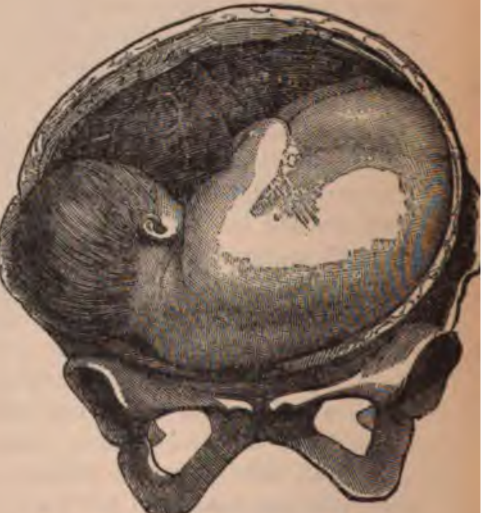


FIG. 180.—PRESENTATION OF THE SHOULDER.

are always accessible. It is true that to recognize the position, if we use the axilla as our guide, we must ascertain the situation of the head. But the main thing is to exactly recognize the presentation, and the presence of the ribs is characteristic of presentations of the trunk. Therefore we may thus classify the landmarks upon the fœtus in the various presentations:

1. For the vertex, occiput.
2. For the face, chin.
3. For the nates, sacrum.
4. For the knees (?), anterior surface of tibia.
5. For the feet, calcaneum.
6. For the trunk, axilla, intercostal gridiron.

There is, however, no such accord as regards the landmarks upon the pelvis; and since each author has selected them arbitrarily, there has resulted a multiplication of positions, which renders their study extremely difficult. In addition to this, the relative frequency of the positions have caused them to be designated by numbers, and as the same numbers do not apply to the same positions with different authors, considerable confusion has arisen. Nægelé and Dubois, therefore, rendered a true service to science and to obstetricians, when they considerably reduced the number of these positions.

They have divided the symmetrical pelvis into a right and a left half. Hence arise the two fundamental positions, and every presenting part must inevitably be either in the right or in the left iliac position. The diameters of the pelvis are four in number: antero-posterior, oblique, and transverse; but the presenting part is never originally in the antero-posterior pelvic diameter. The fœtal part is always therefore in contact with the extremities of the oblique or transverse diameters, especially the former.

The left oblique diameter runs from the left ilio-pectineal eminence to the right sacro-iliac synchondrosis, and the right oblique diameter from the right ilio-pectineal eminence to the left sacro-iliac symphysis. The fœtal part will occupy one or other of the extremities of one of these diameters, and we will have right or left iliac, anterior, transverse and posterior positions:

Occipito-iliac . . .	Right Left	Anterior. Transverse. Posterior.

For the face:

Mento-iliac . . .	Right Left	Anterior. Transverse. Posterior.

For the breech:

Sacro-iliac . . .	Right Left	Anterior. Transverse. Posterior.

The shoulder, that is to say the lateral plane of the fœtus, remains. This lateral plane may present either as a right or a left lateral plane; and according as the back is in front or behind, we will have two positions for each lateral plane, for each shoulder. In each one of these positions the head will correspond to the direction of the axillary fold; we will have an acromio- or cephalo-iliac left or right, of the left or right shoulder. We prefer for our part, in the designation of these positions, to refer to the situation of the head, and we can thus draw up the following table, which comprises at once the presentations and the positions.

TABLE OF PRESENTATIONS AND POSITIONS.

Presentation.	Position.	Variety.
Vertex . .	Left occipito-iliac. Right " "	Anterior. Transverse. Posterior.
Face . .	Left mento-iliac. Right " "	Anterior. Transverse. Posterior.
Breech . .	Left sacro-iliac. Right " "	Anterior. Transverse. Posterior.
Right shoulder	Left cephalo-iliac. Right " "	Anterior. Transverse. Posterior.
Left shoulder	Left cephalo-iliac. Right " "	Anterior. Transverse. Posterior.

Thus we exclude the direct sacral and pubic positions that the older authorities admitted; for they are never primary, but occur during labor as a product of the other positions.

The above positions occur with greatly varying frequency in the different presentations. Statistics are not quite in accord, but the subjoined table gives in order of presentation the general relative frequency of the various positions:

Vertex	1. Left anterior occipito-iliac,	(O.L.A.)
	2. Right posterior "	(O.R.P.)
	3. Left posterior "	(O.L.P.)
	4. Right anterior "	(O.R.A.)
	5. Right or left transverse "	(O.T.R. or L.)
Face	1. Right posterior mento-iliac,	(M.I.R.P.)
	2. Left anterior "	(M.I.L.A.)
	3. Right anterior "	(M.I.R.A.)
	4. Left posterior "	(M.I.L.P.)
	5. Right or left transverse "	(M.I.T.R. or L.)

Thus we see the face positions correspond in frequency to those of the vertex; but the transverse positions appear to us to be a little more frequent.

Breech
1. Left anterior sacro-iliac (S.I.L.A.)
2. Right posterior " (S.I.R.P.)
3. Left posterior " (S.I.L.P.)
4. Right anterior " (S.I.R.A.)

Transverse breech positions are exceptional.

Finally, for the trunk, the right presents a little oftener than the left shoulder, and the back is a little oftener turned to the front than to the rear. We thus have the following order:

1. Left cephalo-iliac of the right shoulder
2. Right " " left "
3. " " " right "
4. Left " " left "

Causes of the Positions.

Vertex.—Spiegelberg has observed that the position of the head depends upon the conformity of the uterus to the pelvis. The back of the child is placed at one side of the uterus, and the head has its long diameter in the longest (transverse) diameter of the inferior segment of that organ. If this transverse diameter and that of the superior strait are parallel, the sagittal suture will descend transversely. If, on the other hand, the transverse diameter of the uterus is in the direction of an oblique pelvic diameter, the head will enter the superior strait in the direction of the oblique diameter. For the fundus uteri is most frequently inclined to the right, and the entire organ has a movement of rotation on its longitudinal axis, which brings its left side nearer the anterior abdominal wall than the right side. Therefore, on this left side must descend the heaviest part of the fœtal anterior extremity, which is the posterior half of the head, and of the back. (Nægelé and Grenser). Hence the greater frequency of OLA.

Tarnier and Chantreuil coincide in this opinion. They claim that, in consequence of uterine obliquity and the prominence of the sacro-vertebral angle, the fœtal ovoid accommodates itself better to the shape of the uterus when the back of the infant is turned to the left and in front, and the flexed head is plunged into the lesser pelvis. As to the right posterior position, accommodation is still easy upon condition that the head extends slowly when it engages deeply in the pelvis.

Face.—Left positions of the face correspond to right positions of the head, and are explainable in the same manner. It is the same for the breech.

As to trunk positions, they are only deviations from vertex or breech positions, and are distinguished only by a greater difficulty of accommodation.

Changes of the Presentations and Positions.

It is by no means uncommon to see presentations and positions change during pregnancy and even at the beginning of labor. Favored by any condition that prevents perfect fœtal accommodation, these changes have been especially studied of late years, and to the labors of Crede, Hecker, Heyerdahl, Valenta, Schroeder, Schultze, Spiegelberg, Sutugin and Fasbender, we owe our precise ideas upon the subject. The further we are from the end of pregnancy, the more frequent are these changes.

Schroeder concludes from his observations:

1st. The fœtal presentation rarely remains motionless from the end of the seventh or the eighth month until the time of labor. In 113 women examined once only, change of presentation was encountered in 31.86 per cent. of the cases. Primiparæ 30 per cent.; multiparæ 36.36 per cent. In 56 women examined twice, change of presentation occurred in 59 per cent. of the cases. Primiparæ 52 per cent.; multiparæ 66 per cent. In 33 women examined three times, change of presentation was found in 76 per cent. of the cases. Primiparæ 72 per cent.; multiparæ 88.9 per cent. In 28 women examined several times, change of presentation was found in 89.3 per cent. of the cases. Primiparæ 89.3 per cent.; multiparæ 100 per cent.

2d. The changes are less common in primiparæ than in multiparæ.

3d. They become rarer as we approach term.

4th. Even when the head is fixed in the superior strait, change of presentation is possible.

5. When the head is completely within the lesser pelvis, change of position only occurs in 10 per cent. of the cases.

6th. Changes are more common with contracted than with normal pelves.

The following table, taken from Schroeder, will show the frequency and variety of these changes of presentations and of positions:

Presentations and Positions.	All cases.	Primipare.	Multipare.
1st position of Vertex into 2nd position of Vertex.	50 times.	33 times.	17 times.
1st " " " 2nd " Breech.	2 "	1 "	1 "
1st " " " 1st " Shoulder.	3 "	2 "	1 "
1st " " " 2nd " "	2 "	1 "	1 "
2nd " " " 1st " Vertex.	71 "	43 "	28 "
2nd " " " 1st " Breech.	1 "	0 "	1 "
2nd " " " 2nd " "	3 "	2 "	1 "
2nd " " " 1st " Shoulder.	5 "	3 "	2 "
2nd " " " 2nd " "	1 "	0 "	1 "
1st " Breech " 1st " Vertex.	3 "	1 "	2 "
2nd " " " 1st " Face.	1 "	0 "	1 "
2nd " " " 1st " Vertex.	9 "	3 "	6 "
2nd " " " 2nd " "	3 "	0 "	3 "
2nd " " " 2nd " Shoulder.	2 "	0 "	2 "
1st " Face " 1st " Vertex.	1 "	0 "	1 "
2nd " " " 2nd " "	1 "	0 "	1 "
1st " Shoulder " 1st " "	4 "	1 "	3 "
1st " " " 2nd " "	7 "	4 "	3 "
1st " " " 2nd " Shoulder.	2 "	0 "	2 "
2nd " " " 1st " Vertex.	4 "	2 "	2 "
2nd " " " 2nd " "	5 "	0 "	5 "
Unknown Shoulder " 2nd " "	2 "	2 "	0 "
" " " 2nd " Breech.	1 "	0 "	1 "

Fasbender, on examination of 418 cases, has come to the following conclusions: 1st. In primiparæ and multiparæ, change of presentation is the rule.

2d. The number of changes found increases with the number of examinations made, and with the number of previous pregnancies.

3d. In multiparæ, seven or more examinations have not enabled us to prove fixity. In primiparæ, on the contrary, the presentation has remained fixed during five explorations.

4th. When six examinations have proved fixity, the seventh has never failed to show a change.

5th. Changes of position are more frequent than changes of presentation.

6th. Primiparity gives us more changes of position than of presentation; multiparity does the reverse.

7th. The older the multiparæ, the more changes occur.

8th. Pelvic contractions favor mutations; and large pelves, on the contrary, favor fixity.

9th. In all cases a large figure favors frequency of change.

10th. Chronic uterine catarrh with abundant secretion, uterine contractions, energetic action of the abdominal muscles, appear to favor mutations.

11th. A pendulous abdomen is not a cause of more frequent mutation.

12th. Neither is a large development of the abdominal cavity. The contrary is the case in hydramnios.

13th. An elevated position of the fœtal presenting part at the ninth, and more especially at the tenth month, favors change.

14th. When the head is fixed above or within the lesser pelvis, mutations are rarer.

15th. During pregnancy, an ascent of the fœtal part, with or without mutation, may be recognized in successive examinations.

16th. A pronounced deviation of the fœtal part towards one of the iliac bones seems to favor changes of presentation.

17th. The presentation appears to be more fixed and constant in infants whose hearts beat with a small average frequency.

18th. The subjective force of fœtal movement appears to be increased by mutation.

19th. In primiparæ, male children, and in multiparæ, female children, most often change their situation. On the whole, sex seems to have no marked influences.

20th. It is in cases where there has been mutation that we have the best developed children, especially as regards length.

21st. It is also in cases where changes have been proved that we most often have abnormal shortness, knots and bands of the cord.

22d. The permanency of the presentation increases towards the end of pregnancy. (Law 3, of Schultze.)

23d. This applies to primiparæ as well as to multiparæ.

24th. It is especially the presentations that do not change towards the end of pregnancy.

25th. After the fortieth week mutation of the presentation in primiparæ has never been encountered.

26th. But we can prove that there occur in them changes in position up to the thirty-ninth week. (The opposite of Schultze No. 6, Law.)

27th. Permanent fixity can only be seen in the last weeks of pregnancy.

28th. In multiparæ the presentation can change until the thirtieth week. In primiparæ, in spite of fifteen examinations, the presentation has remained fixed after the thirtieth or thirty-first week.

29th. The proportion of changes of presentation, as compared with changes of position, remains about equal during the ninth and tenth month in primiparæ (the opposite of Law No. 8, of Schultze). During the seventh and eighth month presentation changes are commoner than those of position.

30th. The second position changes nearly as often into the first, as the first does into the second.

31st. Taken as a whole, the mutations result, in nearly half the cases, in the production of the first position of the vertex.

32d. If in 418 women, at the end of pregnancy, the relative frequency of the first position of the vertex is increased, it results less from a transformation of the second position into the first, than from the transformation of other positions into it. Tarnier and Chantreuil claim that changes of position are commoner than changes of presentation; that the transformation of vertex into breech is very rare, while other presentations often change into vertex, and especially into OLA. That is to say, the changes tend to bring the fœtus into the most favorable position—the first of the vertex.

CHAPTER IV.

SIGNS AND DIAGNOSIS OF PREGNANCY.

THE signs of pregnancy have been divided into rational signs and sensible signs, probable signs, and certain signs.

PROBABLE SIGNS.

The first and most important of all is the suppression of the menses, but it is only of value in women who are usually very regular in their monthy periods. In a certain number of females there occurs during the first months of pregnancy a sanguineous flow, but it is never just like an ordinary menstruation. It varies from it always in quantity or in quality, and if its appearance sometimes falls at the usual catamenial epoch, this is a matter of simple coincidence, for this bloody flow may occur indifferently at any time of the month.

Suppression of the catamenia is not, however, an absolute sign, since we find in all authors accounts of women who have continued to menstruate during the first months and even during the entire period of pregnancy. Durosiez has drawn attention to the persistence of the menses during pregnancy, and the tendency to abortion in women affected with mitral stenosis, at least during the first three or four months. More than this: cases have been recorded where women only menstruated during pregnancy, but these cases are entirely exceptional, and, as a rule, suppression of the menses is constant in pregnant women. Other signs, such as bloating, and modifications of the umbilical cicatrix, have not the least value.

It is the same with the voluptuous sensation and other phenomena experienced by certain women. I have a young patient who is at her fourth pregnancy, and all four times the coitus, that seemed to her to be the impregnating one, was followed by syncope, which had never occurred in other sexual connections.

[A few years ago, Jorissenne called attention to the fact that, in early pregnancy, the pulse rate remained unchanged in changes of position of the woman, and he based on this fact the early diagnosis of pregnancy. Other observers, however, have not found the sign constant. Frey, of Washington, claims that a difference of .7° between the vaginal and axillary temperatures points to pregnancy.—Ed.]

It is different, however, with the changes in the nipple, the appearance of the areola, the tubercles of Montgomery, the presence of milk, which, though liable to deceive in women who have already had children, are of considerable importance in women who have never been pregnant. Some authors, and Cazeaux amongst them, regard them as of such importance as to be an almost certain sign. "In a young woman," says Cazeaux, "who has never had children, whose breast shows a brownish and reddened areola, and the tubercles which we have described, I would diagnose pregnancy almost with certainty." [A statement a trifle too strong, for in cases of ovaritis these mammary signs may be most clearly marked.—Ed.]

Let us note finally the various pigmentations, the brown abdominal line, the violet markings (old markings are white, like old scars) the color of the vulva, etc.—

CERTAIN SIGNS.

The certain signs of pregnancy are:—

1st. Active fœtal movements—perceived by the accoucheur.
2d. Communicated movements, abdominal and vaginal ballottement.
3d. Beating of the fœtal heart.

Each one of these signs alone will suffice for the diagnosis of pregnancy; but they must be recognized by the obstetrician at more than one examination.

For instance, every woman who believes herself pregnant without being so, feels life; therefore, another's hand must perceive the motion. Let us see what means we possess to detect these signs. They are:

1st. External examination.
2d. Palpation.
3d. Vaginal and rectal touch.
4th. The bi-manual palpation.

External Examination.

The inspection of a woman whom we suspect to be pregnant should begin at the face, when we often detect that peculiar brownish pigmentation called "la masque," or chloasma; then the breasts should be examined for pigmented areola, or the tubercles of Montgomery, and for the peculiar markings. The abdomen may be increased in size, and show a pigmentation that extends from the pubes to the xyphoid appendix; this is the brown line. On the sides of the abdominal walls, and down the thighs, peculiar markings may exist, recent ones being of a livid blue, rosy or red, while old ones in multiparæ are white, and look like old cicatrices. The labia majora are more or less puffed up and swollen, the orifice of the vagina is more or less deeply colored, and sometimes shows varices like the labia majora and the inferior limbs; the vaginal mucus membrane is livid, and is bathed with a white or yellowish-white secretion, which is more or less abundant in different women.

The abdomen is more or less prominent according to the stage of pregnancy, so much so as to sometimes fall forward like a sack, but always forming a considerable protuberance, varying with the amount of resistance of the abdominal wall. The umbilical cicatrix may be prominent or depressed, or drawn upwards or downwards; it is always more or less enlarged. Finally, two peculiar phenomena may be noticed. The one is seen in women who have thin abdominal walls, and consists of momentary elevations and depressions of portions of the abdominal surface from active fœtal motions. The other is a special projection of the abdomen seen in some women when they lie curled up in bed. It is only seen in multiparæ, and is due to the projection forward of the uterus between the separated borders of the recti muscles from yielding of the linea alba (eventration.)

At the close of pregnancy the uterus fills the entire abdominal cavity, and the thorax is drawn up high to enlarge the abdominal capacity.

Any of these signs, it is true, might be found in states other than that of pregnancy; taken singly, they do not count for much, but together they have a very great importance.

Percussion has only a very relative value in the diagnosis of pregnancy. It gives us but very incomplete information, and is only of value when associated with other methods of exploration. But it is very different with auscultation, for the hearing of the fœtal heart sounds is a certain sign of pregnancy.

ABDOMINAL PALPATION.

First described by Mercurius Scipio in 1601, then by Dionis, Roederer, Smellie, and Baudelocque, abdominal palpation was not considered of much use to the obstetrician, when Wigand, in 1813, attempted to show its importance and to fix its rules. After him Joerg, Schmidt, Hohl, Velpeau, Devilliers, Chailly, and Hubert de Louvain, described this mode of exploration; but it was Mattei who first developed all its details and showed its importance, not only in the diagnosis of pregnancy, but also for the diagnosis of presentation and position, and for version by external manipulation. Unfortunately his researches were not received by obstetricians with the attention that they deserved, and it is only during the past few years, in France at least, that palpation has been really studied and practised.

Tarnier first returned to it in 1865; he then resumed his researches at la Maternité, and Pinard continued them under his direction (1868). It is only since then that palpation has been practised in ordinary obstetrical routine in France; and it is really to Tarnier and his pupils Pinard, Chantreuil, and Budin that we owe our appreciation of the advantages of palpation and the precise indications which it furnishes.

Palpation permits us not only to appreciate the development of the uterus, and to prove the presence of the fœtus in the uterine cavity, but it enables us to recognize the number, presentation and position of the fœtus, in such a manner that abnormalities can be remedied, and the woman have a normal and physiological delivery, instead of a difficult one. Let us study the rules that are necessary for its practice.

The woman should lie upon her back, with legs and thighs stretched out, and with her arms extended along the sides of the body. In some cases it is advisable to flex the thighs upon the pelvis, and thus relax the muscles of the abdominal walls. [Careful abdominal palpation can only be made with the thighs flexed on the pelvis, in order to obtain as complete relaxation of the abdominal walls as is possible.—Ed.] It is not necessary, however, in most instances. The bladder and rectum should be empty.

The woman should only have her chemise on, and the decubitus should be as horizontal as possible. Pinard protests against the elevation of the thighs—but we ourselves believe that it is of advantage in certain cases. The chemise is then drawn up to the epigastrium, and the rest of the clothes down to the symphysis—so that the abdomen is completely exposed without offending the patient's sense of modesty. The physician places himself on the patient's left side, at the level of the umbilicus.

He then lays one of his hands, which must not be cold, flat on the hypogastric region of the patient, and holds it there for a few minutes so as to get used to the first phenomenon, the contraction of the abdominal muscles on contact with the hand. At the end of a few seconds, their resistance gives way, and the hand can freely explore and outline the shape of the uterus.

In fact, the entire first exploration should be devoted to examining the presence and size of the womb. Beginning at the pubes, the hand is slowly carried upwards, and easily determines the height to which the uterus is elevated. Over the uterus the hand encounters a more or less marked resistance, according to the thickness of the abdominal walls; but this resistance ceases at the level of the fundus, and, by plunging the hand deeply into the wall of the abdomen, we can grasp the fundus itself. When the uterus is far developed this first exploration often permits us to appreciate the presence of more or less mobile solid parts contained in a liquid.

If then the two hands be placed flatly upon the sides of the tumor, there can often be felt an alternate displacement of the solid body from side to side as alternating pressure is made. The displaced body strikes the opposite wall with a kind of shock. This is known as abdominal ballottement. Sometimes these shocks occur of themselves, the hands remaining motionless, and are due to movements of the fœtus; they may be due to movements of the whole body, or of only parts of it, and constitute what Pajot calls the fœtal shock, which is also appreciable, as we shall see, by auscultation. Thus, by the simple application of the hands, we have been able to appreciate the volume of the uterus, and the presence of a living fœtus.

The diagnosis of pregnancy is thus absolutely established. It remains for us to ascertain whether one or more fœtuses are present, and to diagnosticate the presentation and the position. Let us remember that the head is a hard, rounded, and partially displaceable tumor, and that it is separated more or less perceptibly from the trunk by the furrow of the neck, according as the head is more or less flexed.

The nates also forms a hard, rounded, and moderately moveable tumor. But it is less hard, less round, less distinct, and larger than is the head, and, in the normal attitude of the fœtus, it is always accompanied by smaller and more or less prominent and moveable parts, which are the feet.

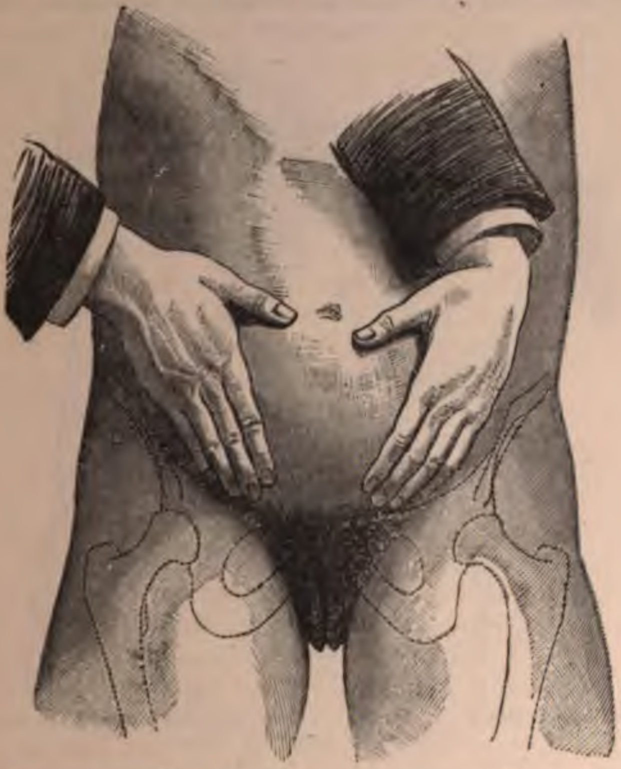


FIG. 181.—POSITION OF THE HANDS AT THE BEGINNING OF ABDOMINAL EXPLORATION. (*Pinard.*)

Between these two parts there stretches a more or less extensive surface, the back of the fœtus. And, since the fœtus is curved upon itself, the back is always more plainly appreciable upon one side of the uterus than upon the other, and, on alternately depressing the two lateral walls of the abdomen, there will be felt on one side a feeling of fullness and resistance that is not felt upon the other side.

Remembering that vertex presentations are the most common, and then those of the breech, the trunk and the face, we must first search for the head. This may be below the superior strait, at its level, or above it.

Placing the two hands flat upon the lower lateral walls of the abdomen, the hands being parallel to the iliac fossæ, and the fingers reaching to the fold of the groin, the accoucheur slowly depresses the abdominal walls, and thus encloses between his hands the area of the superior strait. If the head is at its level, or just below it, it will be encountered somewhere near the median line, and may be seized between the hands. (Fig. 181.)

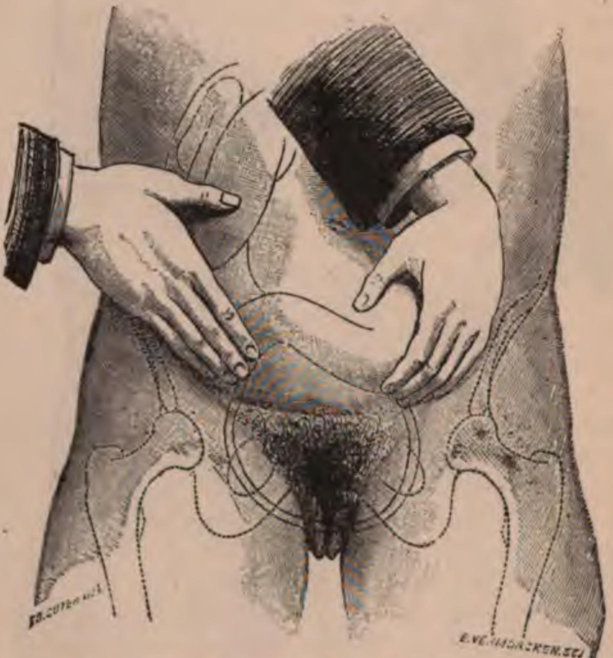


FIG. 182.—THE HAND EXPLORING THE PELVIS, THE RIGHT HAND BEING STOPPED BY THE FOREHEAD, WHICH LIES TO THE RIGHT. (*Pinard.*)

If it is situated above the superior strait, it will be moveable; if a little engaged, it is moderately mobile. If it is entirely engaged, it is almost immoveable, and only the base of the head can be appreciated. Then, if we forcibly press our fingers into the furrow, we will reach a hard, round, and prominent tumor, which is the head. When, however, the head is above the superior strait, one hand alone, laid flatly just above the symphysis, will appreciate both its presence and its mobility.

When, however, the head is more or less deeply engaged, it is necessary to use both hands; and Pinard has drawn attention to the fact that, when the head is flexed, as it must necessarily be for engagement, there must be a depression of the occipital protuberance on the one side, and an elevation of the forehead upon the other. In consequence of this, one hand will encounter more resistance than the other, and will penetrate less deeply. The most depressible side will correspond to the occiput, and the other to the forehead; and this will give us at once the direction of the back, which will always, of course, be upon the side opposite to the forehead. (See Fig. 182.)

We cannot too strongly insist upon gentleness during the manipulation —the more gently the pressure is made, the more delicate and precise will be our sensations. Beginners often fail in their attempts at palpation simply because they contract their hands too forcibly. There should be absolutely no force used, since it causes the abdominal muscles and the uterus to contract, and renders palpation impossible. Palpation is only possible in the intervals of uterine contraction, and, when it occurs, we must stop, and begin slowly. The less we cause contractions, the easier will be palpation.

If we do not find the head about the superior strait, we must search for it elsewhere. Perhaps it is in one or other of the iliac fossæ, or it may be far away. In the first case, it is only necssáry to slide the hands a little further to each side, to find the head. Its roundness, its resistance and its mobility prevent our confounding it with the breech.

If, however, the head is not found either at the superior strait, or in the iliac fossæ, it is because the fœtus is not in its normal attitude, and we must then consider the possibility of the next most frequent presentation, that of the breech. It is therefore at the fundus that we must search for the head, although it rarely lies directly at the apex of the uterus.

Most often we find it at one of the lateral portions of the fundus, and in women at term, or near it, it must be searched for just under the false ribs. It will be felt then so distinctly that there is no chance of making a mistake. It can not only be moved with both hands, but one or two fingers will suffice to displace it. It is only necessary, with two fingers laid upon the head, to brusquely depress the abdominal wall, and the head will be felt to glide away quickly, and returning, strike the fingers with a very appreciable shock. This is what we call cephalic ballottement. (Fig. 183.) This sensation, once appreciated, can never be confounded with anything else.

Such are the characters by which we recognize the cephalic extremity. But there are two sets of cases in which palpation gives only imperfect information. The first is that class in which the abdominal walls are extremely thick. In very stout women they are so thick that the sensations obtained by palpation are entirely confused, and it is hardly possible to recognize the fœtal parts. The second is the class of cases in which the abdomen is entirely relaxed and sack-like. The uterus falls down upon the thighs and the fundus is the only accessible part. Only when there is a breech presentation is the head accessible; in case the vertex presents it is necessary to have an assistant raise the uterus forcibly, and even then palpation can be only very imperfectly performed when there is any amount of adipose tissue. But in these cases the smaller fœtal part, the only accessible one, may be felt in the fundus uteri, and the presence of the head at the other extremity may be deduced, though it may not, in exceptional cases, be perceptible to the touch. We have ourselves recently seen two examples of this.

Thus we see that the head is easily appreciable. The breech is found opposite to the head.

When the head is below, the examiner places his hands upon the superior portion of the uterus, and searches for the place occupied by the breech. This forms a more or less rounded, voluminous, and resisting mass;—but the proximity of small, prominent, hard and mobile parts, and the absence of one peculiarity distinguishes it from the head. That peculiarity consists in the separation of the head from the trunk by a pronounced furrow, the neck, while the breech is continuous without

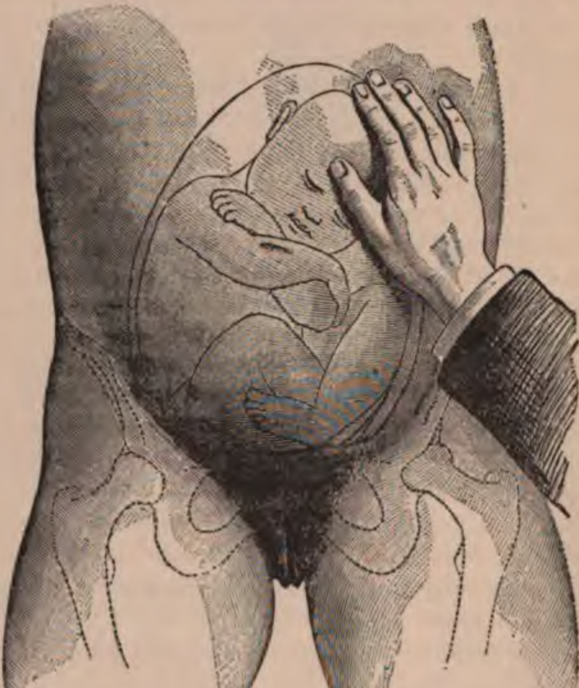


Fig. 1.83—Hand depressing the Abdominal Wall, to obtain the Sensation of Cephalic Ballottement. (*Pinard.*)

interruption with the trunk and back of the fœtus. Thus, instead of a rounded body sharply separated from the main mass, we have simply the rounded end of that mass itself. Let us further add that the breech is never so mobile as the head, and this, with its volume and irregularities, will prevent error on the part of an examiner of some little experience.

It is still necessary to determine the position of the back. The fœtus being flexed, the back is necessarily nearer to one abdominal wall than to the other, and it is easy, by pressing down upon alternate sides, to determine upon which one meets with the most resistance. This will be the back, and on the other side will be felt some small mobile parts, the limbs of the fœtus. Since these always occupy the anterior plane of the fœtus, that will suffice for its diagnosis.

Nevertheless, when the abdominal wall is thick, the fœtus very moveable, the amniotic fluid abundant, it is sometimes difficult to decide these points. Budin, in these cases, counsels us to seize the breech with the hand, and to push it against the cephalic extremity so as to accentuate the flexion of the fœtus. The fœtus, thus forcibly curved, applies its back more closely to the abdominal walls, and allows us to outline it very exactly.

We shall see, when we come to consider delivery, the special diagnosis of the presentations and the positions.

BALLOTTEMENT.

Ballottement is a peculiar sensation that is felt upon giving the fœtus an impulse so that it moves wholly or in part in the uterus; when, in fact, motion is imparted to the fœtus.

When this impulse is transmitted through the abdomen, it is abdominal ballottement, when through the vagina, it is vaginal ballottement. We will reserve the latter until we come to study the touch.

Abdominal ballottement may be effected in different ways. Placing the hands upon opposite sides of the abdominal walls, and communicating a sharp impulse upon one of them, the fœtus can be felt to be displaced, and to strike the other hand with a sensation of shock. Or a single hand may be laid upon the fœtal part, and, upon giving an impulse to it, it may be felt to return and strike the hand. In both cases the sensation perceived by the fingers is analogous to that perceived when, with the finger, a piece of ice floating in a glass of water is sharply tapped. This sensation is never more pronounced than when the displacement of the fœtus is only partial, as in what is called cephalic ballottement. We have seen, that it is especially when the head is in the upper part of the uterus that it can be perceived. When both hands are used, there is a double sensation of shock, of departure and return of the fœtus. For ballottement to be practised, certain conditions are necessary: 1st. The uterus must be developed enough to project considerably above the pubes. 2d.

The fœtus must be developed and solid enough to offer a certain resistance. 3d. There must be a certain quantity of liquor amnii, as compared with the bulk of the fœtus, to insure mobility. It is, therefore, only after the fourth month of pregnancy that ballottement can be properly obtained; and it is especially useful at the sixth and seventh months, when the conditions most favorable for it are present. Before this, neither fœtus nor uterus are sufficiently developed; later, the fœtus is too large, and the quantity of amniotic fluid is too small. Of course hydramnion, twin pregnancies, etc., prevent ballottement.

Ballottement is a certain sign of pregnancy; nevertheless, Pajot has recorded a case in which he was able to perceive it, and yet in which the woman was suffering not from pregnancy, but from a multilocular ovarian cyst.

ACTIVE FŒTAL MOVEMENT.

Besides the communicated and passive movements of the fœtus, which constitute ballottement, the embryo shows proper and spontaneous or active motions.

It is hardly until four, or four and a half months, that active fœtal movements are perceptible to the mother; and even then it is only a kind of tickling, a trembling, which, insignificant at first, increases as pregnancy advances, until these fœtal motions may occur sometimes so violently as to be extremely painful to the mother. It is not until five, or five and a half months, that they become perceptible to the obstetrician. We shall see that auscultation enables us to appreciate them much earlier.

These motions are of two kinds. Some are very extended, and cause considerable change of shape in the uterus; they are due to a total displacement of the fœtus. Some are due to movements of the head and especially of the limbs, which strike the uterine wall sharply and cause it to bulge out at a certain point. The women then say that they feel life at such and such a place.

All infants are not equally active in their movements, and the movements themselves vary in frequency at different hours of the day. It is usually in the morning, when the woman is just awakening, that they are most active; at other times they appear with certain motions or attitudes of the mother. They may be very marked for several days, and then cease for twelve or twenty-four hours, or even more. A cessation prolonged beyond this point is, however, of very great importance, especially when the cessation has not been sudden, but has been preceded by a gradual diminution in intensity of the movements. It often means the death of the child, though auscultation is necessary to decide the point. Certain circumstances may prevent the perception of active fœtal movements. Hydramnion, paraplegia, ascites, will do so. Finally, Mauriceau, Cazeaux and Campbell have cited cases in which fœtal motion was never perceived by the mother, although the pregnancy ran a perfectly normal course. It is generally admitted that the periods during which motion is not felt, are those during which the child is sleeping; while it is awake during those in which they are felt.

Abdominal palpation is the best mode of awakening active fœtal motion; it usually causes fœtal reaction, and total or partial movements. The recognition of active fœtal motions is a certain sign of pregnancy; but the motions must be perceived by the accoucheur. If we rely upon the evidence of the woman we will fall into grievous errors. In fact all women who are tormented either with the desire or the fear of having children, believe that they feel life; and it is especially in women at the menopause that one must be cautious, and not deliver judgment until one has with certainty perceived active movements.

[Under the head of abdominal palpation, reference should be made to intermittent uterine contractions, which, almost infallibly, are peculiar to the uterus, which contains a product of conception; such contractions may be felt as soon as the uterus has ascended above the pubes, and they may be evoked by pressure or friction over the fundus. At an early stage of gestation, the third to the fourth month, the bladder should especially be emptied before endeavoring to obtain this sign.

For this sign we are indebted, in particular, to Braxton Hicks. It is a constant sign, it is not simulated by any other condition, and, as we will note under the head of extra-uterine pregnancy, it is, in our opinion, the most valuable of all our radical means of reaching a differential diagnosis. —Ed.]

AUSCULTATION.

Mayer, of Lausanne, first conceived the idea of discovering the existence of the fœtus by auscultation, but he did not appreciate the full importance of his discovery. It was not until 1821 that Lejumeau de Kergaradec explained the results furnished by obstetrical auscultation, and the advantages to be derived from its employment. The ideas of Kergaradec, at first opposed, were soon disseminated through Germany, England and France, and were defended, from 1831 to 1839, by P. Dubois, Bodson, Kennedy, Kohl, Kilian, Velpeau, Jacquemier, Stoltz and Carrière. In 1839, Depaul applied auscultation to the diagnosis of fœtal presentations and positions, and after that time, all obstetricians adopted it. Finally, in 1847, Depaul's "Traité d'auscultation obstetricale" appeared, and at the present time it still remains the most complete work on the subject.

Obstetrical auscultation should generally be undertaken with the woman occupying the dorsal position, the legs being extended or the thighs flexed. In some cases the lateral decubitus is advantageous. The stethoscope should always be used, and it is generally advisable to apply it directly to the abdominal wall, in order that auscultatory signs may be clearly and directly transmitted. The stethoscope should be neither too long nor too short, and should have an end-piece sufficiently large to cover considerable surface on the abdominal wall. The auricular extremity should be sufficiently large, and should possess such a shape as to easily adapt itself to the ear. It should be placed perpendicularly to the abdominal parietes, and should be maintained in position by the accoucheur's head alone. Maygrier suggested vaginal auscultation. Nauche even devised a special stethoscope for this purpose, and called it a metroscope, but the principle and the instrument had been forgotten, when they were recently revived by Verardini. This method is not likely to become popular, for very few women would submit to it, while none reject abdominal auscultation. On auscultating the abdomen of a pregnant woman, one perceives several sounds, some of which are maternal, while some are fœtal. Some of these sounds are independent of pregnancy, as, for example, the gurgling of the intestines, the muscular fremitus, and the sounds originating in the maternal circulatory apparatus, whether in the heart or in the large pelvic vessels. Other sounds are directly dependent upon pregnancy. These are the uterine souffle, the fœtal heart sounds, the fœtal or umbilical souffle, and the sounds due to active fœtal movements. We consider the sounds emanating from the fœtus only as certain signs of pregnancy.

1st. *The Uterine Souffle.*

The uterine souffle, at one time considered a certain sign of pregnancy, has been robbed of its importance by the discovery that it may be developed in any unimpregnated uterus which has become notably enlarged. Nevertheless, since pregnancy is the most frequent cause of uterine enlargement, since the uterine souffle always coexists with pregnancy, the presence of the souffle should always suggest the possibility of existing pregnancy. The uterine souffle has been successively designated by the terms, simple pulsation with souffle (Lejumeau de Kergaradec), placental pulsation (Ulsamer, Kohl), simple pulsation (Ritgen), placental souffle (Monod), abdominal souffle (Bouillaud), bellows sound (Kohl), epigastric souffle (Kiwisch), uterine bruit (Nægelé), uterine souffle (Dubois and Depaul.)

Character of the Souffle.—The souffle is most frequently slightly vibratory, and separated by a short, yet distinct interval from the succeeding sound, but its chief peculiarity is its occurrence synchronously with the maternal pulse. It may possess either a sonorous or a sibilant quality, but its cycle is separable into three distinct periods, viz.: A period of inception, one of maximum intensity, and one of subsidence. The last period is much longer than the others, and ends in the complete cessation of the souffle. Moreover, it is never accompanied by pulsations as are the other abdominal souffles. It is thus a simple souffle, without pulsations, and isochronous with the mother's pulse. The souffle is generally appreciable at the beginning of the second half of pregnancy, at four and one-half months, but it has been heard earlier, and, in some exceptional cases, Depaul was able to appreciate it during the twelfth and in one case even in the tenth week. Depaul says that there is no part of the uterus at which the souffle may not be heard, but that it is perceived most plainly at the lateral and inferior parts. Early in pregnancy it is, however, best heard in the median line, above the pubes It is not always heard at the same point, nor is it constant. The intensity of the souffle usually increases with advancing utero-gestation, at least up to the seventh month. After that time, the difference is less marked. Depaul does not believe that the intensity of the souffle is proportionate to the intensity of the maternal cardiac action, but considers it stronger in multiparæ. He thinks that the sound is directly influenced by the pressure of the stethoscope, by the fœtal movements, and especially by uterine contractions, which may cause it to entirely disappear. What is the cause of the uterine souffle, what is its seat, and what its mechanism? The oldest theory is that of Hans, who attributed the souffle to pressure of the uterus upon the aorta and the iliac arteries. Adopted by Bouillaud, this theory has since been combated by almost all authors, and recently by Tarnier and Chantreuil. The theory of Laennec and Carrière, advocated by Monod and Hohl, referred the souffle to the placenta. This theory was completely demolished by Bailly, who showed that the souffle persists not only after the expulsion of the fœtus, but, on the average, for two or three days after delivery, and that, in certain rare cases, it can be heard up to the sixth day. The souffle has also been heard in cases of uterine enlargement from fibroids (Charcot). [As also over ovarian cysts.—Ed.]

We owe to Paul Dubois the theory at present accepted, with few modifications, by all obstetricians, and which we ourselves adopt. P. Dubois first established the fact that the souffle could only occur in the uterine walls, and, "having observed that the uterine souffle strongly resembles the vascular murmur which results in an aneurismal varix, from the passage of blood from an artery into a vein, he announced that numerous direct communications exist between the arteries and the veins of the uterus, the walls of which seem formed by a tissue of natural aneurisms, and that the arterial blood, passing directly into the veins, is mingled with the less rapidly circulating venous currents." Dubois, therefore, refers the origin of the souffle to the mingling of the arterial blood with the venous blood, which circulates more slowly. (Depaul). Nægelé denies that it results from the commingling of arterial and venous blood, and locates the bruit in the arteries. Jacquemier denies the existence of direct communications between the arterial and venous radicles, and returns to Bouillaud's theory. Stoltz admits that the souffle originates in the uterine walls, but locates it in the sinuses, situated at the level of the placental insertion. Laharpe and Cazeaux find the cause in the multiplication of vessels in the uterine tissue. Depaul shares the opinion of Dubois, that the souffle is produced in the uterus. The bruit is so superficial that it is evidently produced in the uterine walls. Pajot, Blot, Rotter and Rapin adopt this view, but, for Depaul, the varying calibre of the uterine arteries is the real cause of the souffle. Calling attention to the greater capacity of the veins, he shows that the volume of blood brought by the uterine arteries must be insufficient to fill all their branches, provided that the efflux of blood from the veins be unobstructed. Recalling, also, the fact that liquids circulating in tubes produce no sound, if the tubes are filled, and are of equal calibre throughout, but do cause a bruit under the opposite conditions, Depaul shows that, at the place where the arteries penetrate the uterus, they dilate, and acquire a capacity so great, that the incoming blood is not sufficient to fill them. This disproportion may be produced by different causes, the most common of which seems to be the compression exerted from within outward by the prominences of the fœtal ovoid.

A few years ago, Glenard of Lyons, readopting a theory advanced by Kiwisch as early as 1849, admitted that the souffle was produced in the epigastric artery. Then, forced to surrender by the objections of Tarnier and Depaul, he abandoned the epigastric artery, and located the bruit in an artery situated in the antero-lateral part of the uterus, to which he gave the name of puerperal artery. This was a reversion to the uterine theory. It is then the theory of Dubois, modified by Depaul, which is now generally adopted. To recapitulate: The uterine souffle is a simple blowing sound, synchronous with the maternal pulse, never accompanied by a pulsation, which fact distinguishes it from the other blowing sounds which are sometimes heard in the heart or in the great vessels. Although the souffle is not a certain sign of pregnancy, it is one of great probability, since pregnancy is the state which most frequently developes the uterus, and its vascular organs.

2d. *The Fœtal Heart-Sounds.*

Like the ticking of a watch, the fœtal cardiac pulsations are composed of two distinct sounds separated by a short interval. The first sound is stronger, and more sonorous than the second, which is sometimes very weak, but always audible if the child be healthy. The sounds are heard, according to Depaul, after the end of the third month. We must confess that we have never heard them before the middle of the fourth month, which agrees with the majority of authors, who state the middle of the fourth month as the time of their appearance. After the time mentioned, we have always heard them in all the cases in which we sought for the sounds, if the infant were living. Owing to the great mobility of the fœtus, in the early months the heart-sounds are naturally heard at different points, but as the fœtus tends to assume a fixed position in proportion to its development, the point at which the sounds will be best heard will be that which is nearest to the fœtal heart. The fœtal cardiac pulsations will thus present their maximum intensity at this point, and will diminish proportionately to the remoteness from this point. The average frequency of the heart-beats is from 135 to 140. It is not, however, rare to find children whose hearts beat only 120 times, and others whose heart-beats number 150. Depaul even found one healthy babe whose heart-beats were 160 per minute. The heart's action may, in the same fœtus, be accelerated or retarded, in the former case by stimulation of the fœtus, and in the second by uterine contractions. This retardation is never more marked than during parturition. During labor, the pulsations are accelerated slightly at the beginning of a pain, then they are retarded and diminished in force, even almost completely disappearing during the contraction, but resuming their normal rhythm as the pain diminishes and disappears.

The life of the fœtus is generally not endangered by the inhibition of the heart. If, however, the uterine contractions be too energetic or too frequent, they may imperil the life of the fœtus. In one case of our own, two years ago, the child was stillborn, after a labor of only two hours. The mother was a primipara. Ten minutes before delivery, the fœtal heart was beating, but the final pains were so extremely energetic and continuous that the child was born dead, and could not be resuscitated by insufflation. The rapidity of the expulsion prevented us from thinking of interference, and our disappointment was the more intense because nothing pointed to the disaster.

The force of the heart-beats varies with the strength of the fœtus, its development, and the greater or less facility with which one hears the sounds. The thickness of the abdominal walls, the greater or less quantity of the amniotic fluid, and the position of the fœtus, are all conditions which must be taken into account. The frequency of the heart-beats bears no relation to the rapidity of the maternal pulse, except when the temperature of the mother exceeds a certain point. Winckel, Runge, and later German authors, have shown that, when the maternal temperature is raised beyond 102.1°, the fœtal heart action is notably accelerated, and that, when the temperature reaches 104.2°, the fœtuses almost always die after having presented an enormous acceleration of their cardiac pulsations. The maternal heart-beats are not easily mistaken for those of the fœtus, even when presenting considerable acceleration. The differential diagnosis is easily made, if a little care is exercised, the maximum intensity corresponding to the præcardium. If the sounds emanate from the mother's heart, their intensity will diminish as the stethoscope is removed from the mother's cardiac region, and the reverse. There is also a point of maximum intensity for the fœtal sounds, but between these two points the auscultator will always find a point of minimum intensity for both sounds, and, according as a given sound is maternal or fœtal, it will grow plainer in proportion as the stethoscope approaches the thorax or the abdomen of the mother respectively.

Diagnosis of the Sex of the Fœtus by Auscultation.

Within recent years an effort has been made to utilize the greater or less frequency of the fœtal heart-beats as a means of discovering the sex of the child. If the pulsations exceed 144 per minute, the child is, according to Frankenhauser, a girl; if below 144 a boy. Dauzats says that more than 145 pulsations show the sex to be female, and fewer than 135 heart-beats render it probable that the sex is male. If the number ranges from 135 to 144, there is no certainty. These observations have not been confirmed, but Budin and Chaignot, as the result of renewed research, reached the following conclusions:

1. There is no constant relation, from a practical standpoint, between the number of fœtal heart-beats and the sex of the child; 2. If the pulsations are repeatedly counted, during the latter months, the numbers, at different examinations, are sometimes the same, but usually very different; 3. Variations of from 15 to 20 pulsations occur in consecutive minutes without apparent cause; 4. There is no relation between the fœtal heart-beats and the weight of the fœtus. Frequent pulsations do not point to a small fœtus, nor do less rapid pulsations prove the child to be of large size.

The discovery of the fœtal heart-sounds thus enables one to affirm, in an absolute manner, not only the existence of pregnancy, but the possession of life on the part of the fœtus. The absence of the sounds proves that the fœtus is dead, provided only that they have been repeatedly and plainly heard at an earlier date, for we have seen that several circumstances might temporarily render the sounds inaudible. One can, moreover, by the aid of the heart-sounds, ascertain the existence of twin or of triple pregnancy. In case of twin pregnancy, one finds two maximum points of intensity, but this is not enough: The distance between these points must be considerable, and between them there must be a point of minimum intensity for both sounds, which should, however, augment in intensity in proportion as the auscultator approaches their respective maximum points. The two hearts must, moreover, have different rhythms. In case of triple pregnancy, one finds three maximum points. Finally, one can ascertain, during parturition, whether the child be weak, or whether its condition be perfectly normal. When the child is well, the heart-beats only change during the pains. If, however, the child is suffering discomfort, the pulsations grow slower, less distinct and irregular. We have thus a certain criterion for the necessity of intervention in the interest of the child.

Diagnosis of the Presentation, and of the Position.

Auscultation is of special use in diagnosticating presentations and positions. According to Depaul, the heart is so situated as to be nearer the cephalic than the pelvic extremity, and, since the attitude of the fœtus is that of anterior flexion, the heart-sounds are most easily transmitted to the ear through the back. The point of maximum intensity will be over the fœtal dorsal region, corresponding to the fœtal pericardium. Now, if the fœtus is presenting by the head, the point in question will always be below a horizontal line dividing the uterus in two equal parts. If the pelvic extremity is presenting, the point will be above the line. The umbilicus can not serve as a landmark on account of its variable position. The line dividing the uterus into two equal parts sometimes passes above, and sometimes below the navel. This explains the errors of those observers who draw the horizontal line through the umbilicus. Ribemont has shown, by his recent researches, that the heart is situated at about equal distances from the cephalic and the pelvic extremity, and, although admitting the division of the uterus into two equal parts, he refers the difference as regards auscultatory signs, in the two cases, to the engagement of the head, in cephalic presentations, and to the low position of the heart resulting from the descent of the trunk. In pelvic presentations, on the other hand, the heart is found at the upper part of the uterus. In head presentations, the maximum is below, in breech cases,

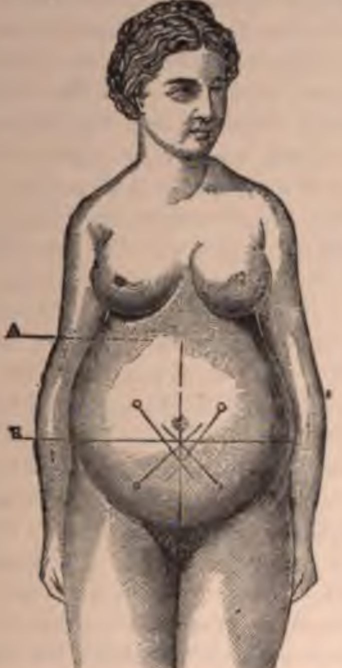


FIG. 184.—DIAGNOSIS OF THE PRESENTATIONS AND THE POSITIONS OF THE FŒTUS.

above the horizontal line. If abnormal conditions, such as faulty insertion of the placenta, deformity of the pelvis, an abnormally large head, or failure of the head to engage, detain the head above the superior strait, the heart-sounds are heard at a higher point. But, whatever Tarnier and Chantreuil may say to the contrary, we do not believe that the cardiac sounds are ever heard, in head presentations, above the level of the horizontal line, as happens in pelvic presentations. To recapitulate: A. Head presentations; sounds heard below the horizontal line, dividing the uterus into two equal parts. B. Breech presentations; sounds heard above the horizontal line. C. Face presentations. Depaul denies that one can recognize face presentations by auscultation, and we believe that the diagnosis by means of auscultation, alone, is about impossible. If, however, we combine auscultation and palpation we may easily make the diagnosis. Let us remember that the point of maximum intensity corresponds to the fœtal cardiac region, and that, in head presentations, the sounds reach the ear through the back. Now, as Tarnier remarks, in face presentations, the head being extended, and the occiput in contact with the back of the fœtus, the back is no longer applied to the uterine wall, and the fœtal dorsal region is no longer in close proximity to the uterine parietes. The heart-sounds will, therefore, be directly transmitted to the ear through the fœtal cardiac region. In this case, palpation and auscultation are at variance. While, for example, palpation shows the back to be directed toward the left, auscultation will give a maximum intensity at the right, at a point directly opposite to that where it should be found in a head presentation. Besides, as a result of the failure of the head to engage, the sounds will be heard higher, but will still remain below, or at least on a level with the horizontal line dividing the uterus into two equal parts. This disagreement between the results of auscultation and of palpation will excite attention and elucidate the diagnosis.

Presentation of the Trunk.—We do not share Depaul's opinion to the effect that transverse presentations may be recognized by auscultation, for, although the line of diminution of heart-sounds does extend in a transverse direction in these presentations, this rule is not without exceptions. The fœtus is never horizontally, but always obliquely placed in transverse presentations, its back is at times in front and again behind, and finally the fœtus is more or less below the superior strait, in which case palpation is superior to auscultation.

Diagnosis of the Positions.

If, upon a transverse line dividing the uterus into two equal parts, one erects a perpendicular connecting the ensiform cartilage and the symphysis, this line will divide the uterus into four parts, two on the right and two on the left. Now, we may state, in a general way, that, in the cardinal positions, in the right and left positions, independently of their variety, the maximum of the heart-sounds will correspond to one of these four segments.

In head presentations, O. I. L., the maximum will be in the left inferior segment. In head presentations, O.I.R., the maximum will be in the right inferior segment.

In face presentations, M.I.L., in the left inferior segment.

In face presentations, M.I.R., in the right inferior segment.

In breech presentations, S.I.L., in the left superior segment.

In breech presentations, S.I.R., in the right superior segment.

Confining ourselves to head and breech presentations, let us see if one can differentiate between the different positions. We have admitted two chief varieties: anterior, posterior. The third, or the transverse, is only a sub-variety of these. Whether we admit with Depaul that the heart-sounds are transmitted directly through the back, or with Tarnier, Chantreuil and Ribemont, that they are conveyed by the thoracic walls, it is plain that the sounds will be clearer in proportion as the part transmitting them is more accessible to the stethoscope. If we now take each of these positions in order, we will see that we can easily reach a diagnosis.

1. O.L.A. The back, or the side of the thorax which is most accessible, looks forward and to the left, so that the heart-sounds will be heard on a line extending from the left ilio-pectineal eminence to the umbilicus.

2. O.L.P. The back, or the most accessible side, is directed backward and to the left, and the maximum intensity will extend along a line running from the left sacro-iliac synchondrosis to the umbilicus.

3. O.R.A. The back, or the most accessible side, being in front and to the right, the maximum intensity will be found on a line passing between the right ilio-pectineal eminence and the umbilicus.

4. O.R.P. The back, or the most accessible side, being behind and to the right, the maximum intensity will extend along a line uniting the right sacro-iliac symphysis and the umbilicus. In any case, consequently, the maximum of intensity will be, in the two inferior segments, below the horizontal line dividing the uterus into two equal parts, and in front or behind according as the position is anterior or posterior.

In breech presentations, the conditions will be the same with this difference, that the maximum will be above the horizontal line, and in the right or left segments, in front or behind, according to circumstances. Thus:

1. S.L.A. Maximum in the left superior segment, on a line extending from the middle of the last left false rib to the umbilicus, at a point near the median line.

2. S.L.P. Maximum on the same line, and in the same segment, but more posteriorly at a point remote from the median line.

3. S.R.A. Maximum on a straight line extending between the last right

false rib and the umbilicus, in the right superior segment, at a point near the median line.

4. S.R.P. Maximum on the same line, and in the same segment, but at a more posterior point, at a point remote from the median line.

Tarnier and Chantreuil seek to show that Depaul's conclusions are too absolute, and give as the maximum points:

O.L.A. A line passing from the navel to the left antero-superior iliac spine, and *not* to the ilio-pectineal eminence.

O.L.P. Maximum behind the ilio-umbilical line, or at the level of this line.

O.R.A. Maximum on the median line, or a little to the left of the median line.

O.R.P. Maximum on a line passing from the umbilicus either to the right ilio-pectineal eminence, or to the right antero-superior iliac spine. They also say that Depaul is too positive regarding the breech positions. We hold that these authors, who are right from a scientific standpoint, go too much into detail. The diagnosis of the cardinal positions, whether right or left, suffice during pregnancy, and the landmarks of Depaul lead surely to it. So far as the diagnosis of the variety is concerned, it is of little moment before labor, and only palpation can afford exact information as to whether the position be anterior, transverse or posterior. We hold that the landmarks of Depaul, although not absolutely exact, are sufficiently so for practical purposes. This is particularly true of face presentations. The main point is to recognize the presentation at once, and we admit the possibility of so doing. The diagnosis of the cardinal position, whether right or left, is established by the mere diagnosis of the presentation.

The Fœtal Souffle.

This souffle depends on the fœtal circulation. It differs from the uterine souffle in that it is synchronous with the fœtal pulse, and in that it is always accompanied by a pulsation. Sometimes this souffle is produced in the fœtal heart, and sometimes in the vessels of the funis, whence the names cardiac souffle, intra-cardiac souffle, fœtal souffle, umbilical or funicular souffle, applied to it by various authors. Thence, also, the differences which it presents, according as it emanates from the heart or from the vessels. When produced in the heart, it is persistent, is heard after birth, and then, according to Scanzoni and Virchow, generally depends on a cardiac lesion, or may occur without a lesion. (Skoda, Scanzoni). This souffle is rare. The souffle produced in the funis is less rare, but is variable and intermittent, is heard now at one point, now at another, and when it disappears, reappears after an interval varying from a few minutes to several hours. Moreover, while the cardiac souffle is always best heard over the præcordium, the umbilical souffle is heard just as well at a distance. First noted by Kennedy, and then by Depaul, Devilliers, and Charrier, this souffle was, by them, attributed to knots in the cord and consequent compression of the umbilical vessel. But this view is too narrow, since many children are born with the cord encircling the neck, the limbs or the trunk, without ever having presented the fœtal souffle. It is now held that the souffle is due to compression of the cord between the fœtus and the uterine wall. (Charrier). Pinard believes that the souffle owes its origin to a diminution in the calibre of the umbilical vessels, due to folds or valves in the vessels. According to Pinard, the sound is single if the veins or arteries separately present these valvules, but double if both sets of vessels contain them. This explanation, although correct for some cases, does not explain all, for, were it universally applicable, the souffle should be permanent, and it is *not*.

Sounds due to Fœtal Movements.

Auscultation of the uterus reveals certain sounds at the moment when the fœtus moves. Some of these sounds, being slow and prolonged, are due to friction. Others are occasioned by impact of the fœtal limbs against the uterine wall. Pajot, who has carefully studied the sounds, and called them sounds of fœtal impact, shows that the ear simultaneously perceives the noise of the shock, and the sensation due to fœtal movement, and that, since these sounds may be appreciated after the third month, before movements are perceptible to the hand, they constitute an excellent sign of pregnancy at a time when other sure signs are wanting. Later on in pregnancy, the shocks are sometimes produced with pendulum-like regularity.

EXAMINATION BY THE FINGER.

The touch may be either vaginal or rectal. Some authors add another variety, the vesical. The essential obstetrical touch is vaginal and rectal, and vesical touch should only be employed in cases of absolute necessity. The vaginal touch is the mode of exploration which furnishes the most information to the accoucheur, but it must be combined with external palpation and auscultation, and in order to obtain all the information which the examination of a pregnant woman can furnish, one must avail himself of all three modes of investigation. Moreover, the results of all three methods must coincide. Owing to natural feminine delicacy, the obstetrician often limits himself, during pregnancy, to external palpation and auscultation, but, if he encounters obscure points or is in doubt, he must not hesitate to employ the vaginal touch, which alone can furnish certain indispensable data, in many cases. Vaginal touch shows not only the existence of pregnancy, but the presentation, the position, the condition of the soft parts, the dimensions of the pelvis, the changes in the cervix and in the uterus, and the progress of labor.

"He who hurts," says Pajot, "examines wrongly," and the proposition is equally true if reversed. It is therefore necessary to possess the *tactus eruditus* in order to avoid giving the woman pain, and to derive the greatest benefit from the touch. The finger must acquire the habit of making the examination, and the practised finger will always put the untrained finger to shame. The accoucheur whose fingers are long has certain incontestible advantages. but the finger must, above all things be practised, for, as Cazeaux says, "the finger grows long from practice." The examination should be made with a single finger, and not with two fingers, as Joulin and certain German authors recommend. The information furnished by a single finger is much clearer and more precise, and only in exceptional cases should one have recourse to two fingers. In these cases, even two fingers are generally insufficient, and one must introduce the whole hand, anæsthesia having been induced, both to spare the woman pain, and to facilitate the examination. The woman being examined by the finger may stand up or lie down. The latter position is preferable, both for the woman and for the examiner. The woman then assumes the dorsal decubitus, the thighs being flexed, the legs resting on the thighs, the heels closely approximated to the nates, and the thighs slightly separated. If the woman stands up, she should be placed against a resisting object, as a wall or a door, the body being slightly bent forward. The obstetrician should accustom himself to practice vaginal touch with either hand, for sometimes the examination is easier with the left hand, or the position of the bed may necessitate the use of that hand. The finger should be anointed with some unctuous substance, as oil, pomade or cold cream, for the double purpose of facilitating the introduction of the finger within the genital canal, and of guarding it from contact with vaginal secretions, chancres or mucous patches. The woman being recumbent, the accoucheur takes his place at the right of the patient, if he proposes to use his right hand, but at the left in the other case. Passing his hand under the bed clothes, without exposing the patient, he places it between the thighs, holding the thumb and fingers doubled into the palm, and the index finger, only, extended. It is best not to pass the hand under one thigh. Lowering his hand, so that the index finger is directed vertically to the axis of the arm, the accoucheur advances the finger in a straight line until he encounters the perineal groove, alongwhich he passes gently, from above downward [it is preferable to pass the finger from below upward, and thus avoid touching the clitoris—Ed.], to remove the hair which may cover the vulvar orifice. Then, replacing his finger in the perineal groove, he passes slowly upward over the anus, the perineum and the posterior vulvar commissure. He now clearly feels the opening left by the separation of the labia majora, and by the vaginal and vulvar orifices. The examiner now quickly extends the hand, and protruding the index finger, which is still extended, he penetrates easily, and without fumbling, into the vagina and passes upward and backward, until the hand is arrested by the perineum. As the finger advances, the elbow must be depressed so that, when the finger reaches the end of the vagina, the elbow shall rest on the bed. It is sometimes well to elevate the woman's buttocks upon the unemployed closed hand, so that the elbow may be farther depressed, and the finger thus made to penetrate farther. We generally prefer to keep the thumb and fingers flexed upon the palm. Other accoucheurs keep the fingers flexed but the thumb extended. This plan has the disadvantage that, when the finger is carried far into the vagina, the extended thumb forcibly impinges against the vulva, causing the woman severe pain, and diminishing the reach of the finger. We ordinarily hold the other fingers flexed upon the palm, but it is sometimes useful to leave them extended. They are then placed in the hollow between the thighs, below the perineum, which they push upward, thus permitting the index finger to penetrate more deeply. The gentle passage of the finger across the genitals serves to push aside the hair, and to reveal the condition of the parts as regards softness, swelling, tumefaction, or the presence of varicose veins, vegetations, cicatrices, prominences, depressions or of mucous patches. Should any of these abnormal conditions obtain, its exact character should be ascertained. [For his own protection, the accoucheur should always examine with the eye the genitals of any woman about whom he is in doubt, before touching them with the finger. He thus will avoid, in particular, specific infection.—Ed.] The accoucheur should first examine the anatomy of the vagina, its length, its dimensions, and the smooth or rough character of its surface. He should look for cicatrices, for septa, tumors and other lesions, making as complete an examination as possible. He next examines the cervix, the uterus, and the bony pelvis.

In order to reach the cervix, one must remember that its characters are changed by utero-gestation, which, while it leaves the length of the cervix unaltered, modifies considerably its consistency, its direction, its situation, and its form. Even these modifications are not identical in primiparæ and multiparæ. The cervix is found at the fundus of the vagina, and, according as the uterine axis is directed forward, backward, to the right or to the left, the cervix is carried more or less downward, upward, to the left or to the right. It forms a more or less soft prominence of varying length, having the consistence of jelly, and is therefore easily mistaken for the soft parts around it. At the summit of this gelatinous mass is a more or less marked depression, the os externum. One must accustom himself to recognize the cervix by its exterior. Unfortunately, students rarely do so, and beginners, for the sake of certainty, introduce their finger into the orifice. This is a gross blunder, for the introduction of the finger, although generally harmless, may have serious results. One should never introduce the finger into the os, unless it be dilated by parturition, and even then, the utmost gentleness and caution should be employed. How, then, may one surely reach and recognize the cervix? Budin advises to follow the anterior vaginal wall from before backward, and then by a movement of circumduction, to make the finger traverse in succession, the left lateral cul-de-sac, the posterior cul-de-sac and the right lateral cul-de-sac. If the cervix is not thus encountered, it is easy to find it in the centre of the circle thus described. Our method is as follows: The fundus of the uterus is most often inclined to the right, so that the cervix is on the left. The uterus is also inclined forward, and the cervix is therefore directed backward. We must, therefore, seek the cervix to the left and behind. We advise the student to follow the left lateral vaginal wall up to the bottom of the vaginal cul-de-sac. In carrying the finger thence toward the right, and in flexing the two first phalanges upon the third, one almost necessarily encounters the cervix on the way. There is, however, a slight difference between primiparæ and multiparæ, and according to the given period of pregnancy. Up to the sixth month, indeed, the cervix ocupies about the same position both in multiparæ and in primiparæ. The uterine inclination is not yet pronounced, the fœtus has not yet engaged, and the cervix is approximately in the median line, but more or less displaced backward. After the sixth month, the uterus inclining more to the right, the cervix is carried more to the left; but there is another cause in primiparæ, the engagement of the fœtal head. The finger is then arrested, before reaching the cul-de-sac, by a hard, round, prominent object which fills this vaginal vault, and around which the finger must pass to reach the cervix. We more easily reach the left lateral cul-de-sac by following the left lateral vaginal wall. If the cervix be not found in this cul-de-sac, the finger will inevitably encounter it in passing around the posterior surface of this hard and prominent object. In multiparæ, the fœtal engagement being absent or less pronounced, the cervix lies further forward, lower, and nearer the median line. The same conditions obtain in primiparæ, when the fœtus does not engage. Having found the cervix, the accoucheur seeks to ascertain its form, its consistency, its length, its volume, its direction and its situation. We should then proceed to examine the inferior segment of the uterus. It appears as if widened and expanded. Its consistence is soft, like India rubber, and its weight is augmented. It is no longer so mobile as when empty, and is displaced with some difficulty. In this inferior uterine segment we find the fœtal parts, and ascertain the presentation. If the head present, and the patient be a primipara, we feel, after the sixth month, a hard, round, prominent object, recognizable sometimes by the sutures, and sometimes by a parchment-like or osseous resistance. In multiparæ, as a result of the failure of fœtal engagement, we must reach higher to make out these points, and must, in some cases, depress the fundus uteri in order to render the fœtus accessible. If some other part of the fœtus present, as the breech, face or trunk, it is frequently out of reach, and the diagnosis can only be made during labor. At the end of pregnancy the cervix is often very difficult to recognize. We have seen that it is obliterated. In the place of the projection previously found, one now encounters in multiparæ only a little elevation, pierced by an orifice and continuous with the inferior segment of the uterus. In primiparæ the cervix is still more difficult of detection, for, at the same time that the cervix is effaced, the lower uterine segment grows thinner, and the cervix is only represented by a depression without an opening, and with borders no thicker than a sheet of parchment or of thick paper. The untrained finger may pass over it without recognizing it. It is only after the recognition of the cervix that we recommend the movement of circumduction of Budin, which shows the form, consistency and the true situation of the cervix.

BALLOTTEMENT.

Vaginal touch gives another peculiar sensation known as the vaginal ballottement. While Pajot considers vaginal ballottement analogous to abdominal ballottement, consisting in a displacement of the fœtus, *en masse*, with the sensation of impulse due to its return, Depaul holds that this impulse is only exceptionally observed. We feel the displacement of the fœtus, according to him, but not its return against the examining finger. This difference in interpretation is due to the fact that Pajot understands, by the term ballottement, a total displacement of the fœtus, while the ballottement of Depaul merely consists in a partial fœtal displacement. Moreover, while Pajot's ballottement and returning shock or impulse, are hardly perceived except between the fifth and eighth months, Depaul's ballottement may be observed up to the very end of pregnancy, and even in some cases at the beginning of labor. In order that the ballottement with impulse be perceptible, it is necessary, in fact, that the fœtus be very mobile, that it be not too large, and that there be enough amniotic fluid to allow of its being entirely displaced. For Depaul it suffices that one of the fœtal parts, especially the head, be mobile, and this condition exists almost constantly, unless the head is well engaged. In order that ballottement be perceived, the woman may be standing or lying down. It is of the utmost importance to place the finger in front of the cervix, at the point of junction between the cervix and the inferior uterine segment, and not behind the cervix, in the posterior cul-de-sac, and on the posterior uterine segment. The finger, applied as directed, imparts, by its pulp, a brisk movement to this inferior segment. Impelled by this movement, the fœtus is sent upward, in the uterine cavity, and falls back upon the finger, imparting an impulse to it. This is the ballottement of Pajot. For Depaul the method is the same, but the impulse is absent, and, if the fœtus on returning comes in contact with the finger, it is not suddenly, but slowly, and without any shock. Whether there be a shock or not, ballottement is, when perceived, an almost pathognomonic sign of pregnancy, for the cases cited by Pajot and Cazeaux, of ballottement obtained in non-pregnant persons, are so exceptional as only to confirm the rule. The absence of ballottement should not cause us to conclude that pregnancy does not exist, for different conditions may prevent it from being observed. In order that ballottement be made out, the presenting fœtal part must be accessible, and mobile in the amniotic fluid. Now certain conditions remove the fœtus from contact with the finger, or limit its mobility. Some of these conditions are, an excessively large fœtus, a very small one, hydramnios, multiple pregnancies, faulty insertion of the placenta, and abnormal presentations. In some of these cases, if we cannot obtain Pajot's ballottement, we may get that of Depaul.

CONJOINED MANIPULATION.

This is a fourth mode of obstetrical exploration which the Germans, true to their instincts, have endeavored to appropriate, giving it the name of combined exploration. It consists in the association of external and internal palpation,—that is to say, while the finger in the vagina is exploring the cervix and inferior uterine segment, the other hand, applied on the abdomen, grasps the fundus uteri. We thus obtain very precise information regarding the development and mobility of the uterus, and regarding its contents. Combined exploration is particularly useful early in pregnancy, and allows the establishment of a diagnosis at a period when, the certain signs being absent, the probable ones are alone available. While the finger in the vagina perceives the slight cervical changes, its beginning softening, the enlargement of the lower uterine segment, and its weight, the hand placed on the hypogastrium feels, after the end of the second month, or at the middle of the third month, the round, elastic fundus of the uterus a little below the superior strait, or, at the third month, on a level with the same. If we endeavor to raise the uterus with the finger in the vagina, an impulse is transmitted to the hand upon the hypogastrium. If the hand on the abdomen is now made to press upon the tumor, and to depress it within the pelvis, the finger in contact with the inferior segment perceives this depression, and the accoucheur thus definitely decides that the uterus is indeed included between the palpating hands. If, in addition to the uterine enlargement, the rational signs of pregnancy are present, one is almost justified in diagnosticating pregnancy, which is the most natural cause of uterine development. Conjoined manipulation also renders great service in cases of real or threatened miscarriage. This will be again referred to in the article on Abortion. Rectal and vesical touch should be reserved for cases where they are absolutely indispensable, as in examination of girls claiming to be virgins but who are possibly pregnant, in extra-uterine pregnancy, uterine retroversion, fibroids, and other tumors. Vesical palpation must be preceded by dilatation of the urethra, and is very rarely necessary.

It thus appears that the certain signs of pregnancy are four in number: active fœtal movements, perceived by the accoucheur; ballottement, whether abdominal or vaginal; the fœtal souffle. Of these signs, only one is infallible, *viz.* the fœtal heart-sounds. The others may be wanting. We hold that one cannot affirm the existence of pregnancy until between the middle of the fourth and the beginning of the fifth month—that is, after the time when the fœtal heart-sounds are heard. We shall see in the article on Diagnosis, that these sounds may be absent on account of death of the fœtus, and that the diagnosis then becomes very difficult.

[There is a further sign of pregnancy which, in our experience, ought to be classed amongst the infallible, and this is the sign for which we are indebted to Hegar, and which is called after him. For about two years we have examined in the neighborhood of fifty women, primiparæ and multiparæ, for this sign, and have never as yet failed to find it where it had a right to be—in pregnancy—nor have we ever found it in the absence of pregnancy. The sign is perfectly apparent as early as the sixth week, in one case we found it unmistakably at the fourth, and, in our observations, we were always careful to verify, by after examination, the truth of our diagnosis. By means of it, we have made the diagnosis where all rational history was purposely withheld from us by the patient.

The sign depends on the fact that, during the first eight weeks of gestation, the body of the uterus enlarges, particularly in the antero-posterior diameter, out of proportion to the cervix, which, beyond a little softening at the tip, may not alter at all. In making the bi-manual, then, and this is a *sine qua non*, the lower uterine segment is found to project over the cervix, and, further, this segment seems boggy and compressible. In a paper on this sign, published in the *Medical Record* (New York) early in February or March of this year, we likened the shape of the uterus to "an old-fashioned fat-bellied jug"—and this describes it very well.

This peculiar shape of the uterus is not simulated by anything else. In subinvolution, the body of the uterus is enlarged in all its diameters: in hyperplasia, the body is dense, not elastic, doughy, resilient: in hyperemia, from obstructed circulation due to marked flexion, compressibility is absent, and the uterus is not spherical: fibroid in the anterior wall will project over the cervix, but it is dense and uneven.

Being able thus to differentiate every other condition, and the sign never having failed, or misled us, we naturally are inclined to consider it as positive of pregnancy.—Ed.]

STAGES OF PREGNANCY.

It is almost impossible to determine, month by month, the stage of pregnancy. Accurate knowledge about the beginning of pregnancy is usually lacking. Between the last normal menstrual epoch and the first missed menstruation there is an interval of at least three full weeks, during which conception may have occurred. This opens the way for considerable error. The usual way is to add ten days to the time of the last regular menstruation, and to date pregnancy from that point, but every obstetrician recognizes the unreliability of this method. This accounts for the so-called anticipations or retardations of labor, which have no real existence, but are due to errors of calculation. We will not attempt to follow the development of pregnancy, month by month. There are, however, three stages of pregnancy during which, in physiological utero-gestation, the woman being well proportioned, the size of the fœtus moderate, the quantity of amniotic fluid normal, and the presentation regular, one finds practically the same conditions. These three epochs are at three months, six months and at term. At the third month, the fundus uteri reaches to the level of the superior strait, or somewhat higher. The softening of the cervix is very distinct, and embraces both the mucous membrane, and deeper tissues of the inferior third of the cervix. The external os, which is closed in primiparæ, allows the introduction of the finger, in multiparæ. The mammary changes are evident, the inferior uterine segment is larger and plainly rounded, and, in some cases, one hears the uterine souffle and the fœtal heart-sounds. At the sixth month, the fundus uteri generally reaches between one or two fingerbreadths above the navel. The cervix is softened throughout two thirds of the vaginal portion. The os, closed in primiparæ, is open in multiparæ. The breast signs are strongly marked, and milk is present (colostrum). The fœtal movements are very plain, and one clearly obtains abdominal and vaginal ballottement. The uterine souffle, and the heart-sounds are heard best at this time. The umbilicus is almost effaced. At nine months, the fundus reaches the false ribs, but is lowered a few days before confinement. The cervix, which retains its full length, is softened throughout, and closed in primiparæ. In multiparæ it is funnel-shaped, the lips of the os externum are everted, and the internal os slightly patulous, so that it is often possible to penetrate into the cervical cavity. The fœtus is more or less engaged, (both in primiparæ and multiparæ); ballottement with impulse disappears, while ballottement without shock often remains. Mechanical disturbances of the digestion, and the respiration, are sometimes well-marked. During the last days of pregnancy, the abdomen often sinks, the movements become more free, more or less diarrhœa exists for twenty-four or forty-eight hours, irregular uterine contractions appear at various intervals, and palpation shows the cervix to have been taken up. There is a general sense of comfort, and of deceptive *bien-être*, which is only the prelude of parturition. Ahlfeld and Runge have attempted to calculate the stage of pregnancy from the size of the fœtus. Ahlfeld invented compasses for the purpose, one branch of which, placed in the vagina, rests upon one pole of the fœtal ovoid, while the other branch is applied, externally, upon the superior pole of this ovoid. Ahlfeld concludes that the diameter so obtained is about equal to one half the real length of the fœtus. This method is liable to yield erroneous results.

What has been said about the typical conditions obtaining at three, six, and nine months, applies only to women with normal pelvis. In women with contracted pelvis the fœtus, resting above the superior strait, elevates the fundus notably, so that, if reliance were placed upon this uterine elevation alone, in calculations regarding the stage of pregnancy, we would be exposed to grave errors. One of our colleagues was thus led to produce abortion, supposing that he was about to undertake a premature delivery. Deceived by the elevation of the uterus, and convinced by the repeated assertions of the patient that the last menstruation had occurred eight months before, our colleague induced labor as he supposed, at 7½ months (the pelvis had a diameter of 2½ inches). The child was born alive, but its development was that of 6½ months, at the outside, and it died in a few hours. It was not viable. This shows the importance of exactly calculating the stage and duration of pregnancy.

DURATION OF PREGNANCY.

To exactly compute the duration of pregnancy we ought to know the precise moment of fecundation, which is out of the question. It is therefore necessary to have recourse to the last menstrual period. The authorities are far from agreeing about this. Some believe that conception usually takes place during the eight to ten days following the last menstruation, while others think that pregnancy begins during the eight or ten days preceding the menstrual epoch first missed.

Robin, whose views tend to be more and more adopted, holds that it is the coitus preceding the last menses which furnishes the spermatozoa to fecundate the ovum. He, however, says that this ovum is expelled generally only at the end of the menses, while Schroeder, Kundrat, Engelmann, Williams, and Löwenhardt, believe that the ovum escapes before the blood, and, as Muller justly remarks, we do not possess certain data regarding the duration of pregnancy. It is, indeed, very difficult to gain exact ideas on this subject, for even if we knew the day of the fecundating coitus, we cannot know the moment when the spermatozoa impregnate the ovum. As Schröder says, fifteen days may elapse, after the spermatic fluid is deposited in the genital canal, before the union of the fluid and the ovule is effected.

In France we generally reckon from the last menstrual epoch, and add fifteen days. The Germans count 280 days from the first day of the last menstruation, or nine months and seven days. Simpson counted from the last day of the menstrual flow, not including that day, or from

274 to 280 days. Duncan counts 278 days from the end of the last menstruation. Devilliers reckons between 270 and 280 days after the end of menstruation. Hecker reckons 272 days; Veit, 276; Ahlfeld, 274; Depaul, from 265 to 270. Schmitt counts from the middle of the interval between the last menses, and the time when they should have reappeared, and adds 270 days. Others have sought to establish a relation between the duration of pregnancy, and the menstrual periods. Following in this the example of Harvey and of Stark, Berthold concludes that labor begins from eleven to fourteen days before the return of the tenth epoch, dating from conception. Hohl says that confinement occurs near the tenth menstrual spoch. Mattei concludes that the time when labor most usually takes place is the ninth catamenial epoch after fecundation. More than one half of the confinements said to occur at term, take place exactly in the course of the ninth missing menstruation, after fecundation. Löwenhardt computes the time of confinement according to the duration of the interval comprised between the two last menstruations preceding pregnancy. He thus admits 260, 270, 280, 290 and 300 days. Stadfeldt fixes the duration between 270 and 279 days. Schroeder diminishes the number, fixing it between 250 and 260 days. Matthews Duncan counts 277 days between the cessation of the menses and confinement. Tyler Smith has prepared the following table, which may furnish precious information. It is based both upon the months of the calendar and on lunar months.

TABLE FOR CALCULATING THE DURATION OF PREGNANCY.

Nine Calendar Months.			Ten Lunar Months.	
From Jan. 1st	To Sept. 30th	273 days.	To Oct. 7th	280 days.
" Feb. "	" Oct. 31st	273 "	" Nov. 7th	280 "
" March "	" Nov. 30th	275 "	" Dec. 5th	280 "
" April "	" Dec. 31st	275 "	" Jan. 5th	280 "
" May "	" Jan. 31st	276 "	" Feb. 4th	280 "
" June "	" Feb. 28th	273 "	" March 7th	280 "
" July "	" March 31st	274 "	" April 6th	280 "
" Aug. "	" April 30th	273 "	" May 7th	280 "
" Sept. "	" May 31st	273 "	" June 7th	280 "
" Oct. "	" June 30th	273 "	" July 7th	280 "
" Nov. "	" July 31st	273 "	" Aug. 7th	280 "
" Dec. "	" Aug. 31st	274 "	" Sept. 7th	280 "

Playfair, from whom we borrow this table, calls attention to the fact that it contains two columns, one of calendar and the other of lunar months, and is to be read as follows: A woman ceased to menstruate on July 1st. Her confinement should be expected, at the earliest, on or about March 31st, (end of nine calendar months), or, at the latest on the 6th of April (end of ten lunar months). Another woman ceased to menstruate on January 20th. Her confinement is to be looked for on September 30th, plus twenty days (end of nine calendar months), or on the 7th of October, plus twenty days (end of ten lunar months) at the latest. It is, therefore, evidently very difficult to exactly determine the duration of pregnancy; for, even when there has been only one coitus, the date of which is known, there is still no certainty. Out of thirty-four cases observed by Dr. Reid, the duration varied between 260 and 294 days. Out of thirty-one cases, observed by Raves, the average duration was 272.3 days. In thirty-four cases, observed by Stadfeldt, the average was 271.4 days. French law extends this period to 300 days. Are there cases in which pregnancy continues beyond the ascertained average period, or, in short, is pregnancy ever prolonged? Almost all authors deny this, as regards the human species, although it occurs in certain animals. Müller, in his remarkable thesis, reviewing all the known observations, and discussing the opinions of the believers in prolonged pregnancies shows: 1. That all these cases are examples of extra-uterine pregnancy: 2. That although in cases of abortion, the retention of a dead fœtus until full term is frequent, there is not a single authentic case of retention of an abortive ovum long beyond the ordinary period of gestation; 3. The only cases of retention, in uterine pregnancy, are those in which masses of bone have been incrusted in the uterine walls. But this is very different from retention of an entire fœtus, particularly if it is supposed to have passed through modifications only seen in extra-uterine cysts, such as fatty and calcareous degeneration. Müller, therefore, denies the existence of prolonged labors, and, for him, the "missed labor" of the English is merely the false labor at term in extra-uterine pregnancies.

Villard (Thesis, 1878), although less positive than Müller, holds that physiological prolonged labors do not occur, and that, in reported cases of this sort, an error has been made regarding the date of conception. Labor occurring beyond the normal period of pregnancy has been retarded by varying causes of dystocia, relating either to the pelvis, to a lesion of the maternal or fœtal organs, to the course of labor, to excessive development, or to faulty positions of the child. Indeed, the only conclusive cases which he cites are those of Depaul, cancer of the uterus; of Menzies, the same; of Lefort, cervical atresia; of MacClintock and Schroeder, cancer of the uterus. Now, in all these cases the fœtus was still-born, and the same is true of Herrgott's two cases. We, therefore, say, with all other authors, that prolonged pregnancy, the fœtus being alive, does not exist as a physiological condition. It only exists in the following cases:

1. In extra-uterine pregnancy; 2. In case of a dead fœtus retained in the uterus, as with abortive ova; 3. Finally, in cases where the dead fœtus is retained by obstacles to parturition seated at the cervix. Even in these cases, prolonged pregnancy is very exceptional.

CHAPTER V.

MULTIPLE PREGNANCY.

FREQUENCY AND CAUSES OF MULTIPLE PREGNANCY.

UNDER the term multiple pregnancy, we include all cases in which the uterus contains several fœtuses instead of a single fœtus. When there are two fœtuses, twin pregnancy exists. We may also have triple, quadruple or quintuple pregnancies. Wappoeus noted, among 19,698,322 confinements occurring in Germany, Belgium, Sweden, Denmark, Sleswig-Holstein, Ireland and Austria:

Single pregnancies,	19,468,832	or 98.83 per cent.
Twin "	226,807	or 1.17 per cent.
Triple "	2,623	
Quadruple "	59	
Quintuple "	1	

Spengler-Ploss, among 181,154 births, noted:

Twins,	2,509
Triplets,	2
Quadruplets,	1

Dessauer, of Prussia, found, between the years 1825 and 1855, *i.e.*, during thirty years:

Single pregnancies,	17,753,763	or 98.93 per cent.
Double "	171,270	or 1.07 per cent.
Triple "	2,206	
Quadruple "	47	

Sickel, among 17,730,674 accouchements, found:

Double pregnancies	213,330,	or 1 in 83
Triple "	2,195,	" " 8.077
Quadruple "	46,	" " 385.499
Quintuple "	1,	

Veit, among 13,360,557 births, noted:

Double pregnancies,	149,954	or 1 in 89
Triple "	1,698	or 1 in 7.910
Quadruple "	36	

Hence multiple pregnancies form . . 1 in 80.8 to 1 in 93.5.

Kleinwachter furnishes the following statistics:

	Labors.	Double Pregnancies.	
Collins, of Dublin,	129,172	2.062 or 1.58	per cent.
Hoffmann	6,139	98 " 1.58	"
MacClintock and Hardy	6,634	95 " 1.44	"
Clinic of Prague	4,808	65 " 1.35	"
Spaeth	14,880	185 " 1.24	"
Siebold (Ed. V.)	7,139	89 " 1.24	"
Clinic of Munich	28,379	336 " 1.18	"
Lachapelle.	38,441	441 " 1.11	"
Arneth	39,121	445 " 1.01	"
Bartsch	4,382	42 " 0.95	"
Klein	35,084	325 " 0.92	"

Quintuple pregnancies have been observed by Hull, Chambon, Kennedy, Ramsbotham and Cazeaux. MacClintock and Puech have seen them twice. The proportion of multiple pregnancies is not the same in different countries. The largest relative number is found in England. Thus, among 484,350 labors recorded in England, Germany, and France, there were 6,248 double, 78 triple and 4 quadruple pregnancies, which may be classified as follows:

	England.	Germany.	France.
Double pregnancies	1 in 63	1 in 84	1 in 92
Triple "	1 in 4.311	1 in 7.182	1 in 11.105
Quadruple "	1 in 77.613	1 in 125.693	

Kleinwachter gives the following figures:

Twins.		Twins.	
France,	1 in 92	Denmark and Saxony,	1 in 78.8
Prussia,	1 in 89	Geneva,	1 in 65.5
Wurtemberg,	1 in 86.2	England,	1 in 63
Germany,	1 in 84	Bohemia,	1 in 51

These differences have been referred to latitude, race, the influence of stature and large ovaries. These may have a certain importance, but heredity, and the multiparous state have a much greater causative influence. Double pregnancies are incontestably more frequent with multiparæ than with primiparæ. Lebel, whose work is based on observations made at this clinic, found, among 140 cases: primiparæ, 51, multiparæ, 89; Collins, out of 240 cases, primiparæ, 72, multiparæ, 168. Duncan states the proportions as follows: primiparaæ, 45.90 per cent., multiparæ, 54.10 per cent. The influence of heredity is still stronger, especially on the mother's side. Twin sisters often have twins, and we find, almost always, examples of multiple pregnancies among sisters, aunts, and cousins. The paternal influence must not, however, be denied, and the cases although less numerous, are equally striking. The most remarkable case is that of a certain Russian peasant who, having married twice, had eighty-seven children by his two wives. The first wife had four quadruple, seven triple and sixteen double pregnancies. His second wife had two triple and six double pregnancies. As regards age, the sixty-one twin pregnancies observed by Kleinwachter, are thus classified:

19 years,	1 case.	25 years,	8 cases.	31 years,	1 case.
20 “	2 cases.	26 “	6 “	32 “	2 cases.
21 “	3 “	27 “	5 “	34 “	1 “
22 “	2 “	28 “	6 “	35 “	2 “
23 “	5 “	29 “	3 “	37 “	2 “
24 “	8 “	30 “	1 “	41 “	1 “

Thus, up to 22 years,	13.11 per cent.
from 23 to 29 years,	67.22 “
“ 29 to 42 “	19.67 “

It is, thus, at the time of greatest fecundity, that the largest numbers of twin pregnancies occur. The above figures differ a little from those of Reuss:

19 years,	3 cases.	27 years,	11 cases.	35 years,	1 case.
20 “	2 “	28 “	22 “	36 “	7 cases.
21 “	3 “	29 “	12 “	37 “	6 “
22 “	11 “	30 “	18 “	38 “	4 “
23 “	10 “	31 “	6 “	39 “	3 “
24 “	11 “	32 “	18 “	40 “	1 “
25 “	10 “	33 “	8 “	41 “	2 “
26 “	11 “	34 “	13 “	46 “	1 “

	Wurtzburg.	Prague.
Therefore, up to 22 years,	9.9 per cent.	13.11 per cent.
from 23 to 29 years.	45.4 “	67.22 “
above 29 years	44.7 “	19.67 “
from 27 to 36 years.	35.9 “	
above 36 years	8.8 “	

It is generally admitted that the causes of twin pregnancy are three in number. 1. Two Graafian follicles, either in the same ovary or in different ovaries, mature simultaneously, pass through their evolution and each expel an ovum. 2. A single Graafian follicle contains, at the same time, two mature ova, which are simultaneously fecundated. 3. A single follicle contains a single ovum which possesses two nuclei.

Here arises a mooted question. We refer to super-fœtation, two varieties of which are recognized, super-impregnation (super-fecundation), and super-fœtation proper. Now, although all authors admit the existence of super-fecundation, many deny the existence of super-fœtation. The difference is, indeed, great. Super-fecundation, super-impregnation, is the successive fecundation of two ova belonging to the same period of ovulation. These two ova are fecundated by sexual intercourse, practised, at different dates never far separated, by the same or by different persons. The most convincing facts bearing on this subject are furnished by cases in which negresses, having sexual relations with a white man and a negro, give birth to one mulatto and to one negro. Moreover, there are still more striking cases where white women, having intercourse with one white and one black man, are delivered of one white and one mulatto child. These facts are confirmed by the experience of veterinary surgeons. The characteristic feature of super-fecundation is that the ova belong to the same ovulation. In super-fœtation two ova, belonging to different ovulations, are fecundated after intervals more or less protracted. In order, then, that super-fœtation may occur, it is necessary: 1. That ovulation occur at least once more after the first ovule has been fecundated. 2. It is necessary that the spermatic fluid, having reached the uterus which is developed by pregnancy, should pass between the serotina reflexa and the serotina vera—that is, that the two membranes be not yet united, and that the fluid should penetrate the Fallopian tube, and, arriving at the ovary, come in contact with the newly discharged ovule. The second condition is anatomically possible, since the two serotina are not united before the third or fourth month of pregnancy. The orifice of the tube also remains patulous until this time. The persistence of ovulation during pregnancy is denied by all authors. So long as it is not proven that ovulation may persist during pregnancy, we are not justified in admitting the occurrence of super-fœtation. The arguments advanced by the believers in super-fœtation do not seem conclusive to us. One of these arguments is based on the notable difference sometimes found in the weight of twins, born at the same time; another argument is based on the rarer, but still authentic, cases in which two living and viable children have been born at different and widely separated periods. The following are the intervals in some of these cases: four and one half months, Marianne Bigaud: five and one half months, Benọite Franquet: five months, a woman of Arles: seventeen weeks, a case of Dimerbroeck: six weeks, a case of Lebas: four weeks, a case of Dr. Moebus: fifty-two days, a case of Thielmann: forty-two days, cited by Fordyce Barker: one month, Giuseppe Generali. (*Vide* the thesis of Ganahl, Super-fœtation, Paris, 1867). But, as Depaul says, these observations are all incomplete, —all date from the last century, and do not offer sufficient guarantees as regards the examination of the children or of the mothers. One more argument is derived from the cases of double uterus, or bilocular uterus. Now this malformation has only been observed in two cases, those of Barker and of Generali, and, in the case of the woman Bigaud, the uterus was single. We, therefore, follow the example of Depaul in requiring, before admitting the possibility of super-fœtation: 1st. The proof that ovulation may persist during utero-gestation. 2d. Cases observed by competent accoucheurs, and in which all the conditions pertaining to both mother and child are given in great detail.

A further point of interest is the anatomical relations of the ovum, independent of the fœtus itself. Three conditions may obtain, and they seem to correspond with the three grand etiological divisions already referred to:

1. *Two ova from the same ovary, but belonging to different Graafian follicles.*—The two ovules are independently developed, each one having its own membranes, and, consequently, two chorions and two separate amnions. Each fœtus is thus contained in a separate compartment. At first, each ovum possesses a decidua reflexa, so that when the originally separate ovules become attached to each other as a result of their development, the line of contact represents a septum with six layers, two deciduæ reflexæ, two chorions, and two amnions. But the deciduæ reflexæ having been reabsorbed, there finally remain only two amnions, two chorions and a single decidua vera. Thus, each fœtus has a separate and independent placenta, but the two placentas may form a single mass plainly divided into two parts by a membranous partition. The two circulations are quite independent, and each fœtus has a separate funis. In other cases this septum is wanting, and the two placentas seem to form a single mass possessing two umbilical cords. But, even here, the union of the placentas is only apparent, for the septum still presents the four layers formed by the two amnions and the two chorions. The circulations are still independent.

2. *A single Graafian follicle, and two ovules simultaneously fecundated.*—There are two amnions but only a single chorion The two ova originally came into close relations with each other in utero. There was, at first, only one reflexa, but still two chorions and two amnions, but these chorions became so intimately associated that they finally only formed a single chorion, and the septum was formed of two layers, the two amnions. The two chorions, which at first existed in the septum, have been reabsorbed. In this case the placentas are still united into a single mass, but the independence of the two circulations is not so absolute, and anastomoses between the branches of the two circulations are not rare. According to Jacquemier, these anastomoses are almost entirely venous and superficial, embracing only large venous branches. The independence of the fœtuses, although not so complete as in the former case, is still almost perfect, and hence the possibility of the death of one fœtus and of the survival of the other. Each fœtus here possesses a distinct funis.

3. *One ovule with two nuclei.*—There is, in this case, a single chorion and a single amnion. After fecundation, two embryonic spots appear upon the same blastoderm, and the chorion is single from the start. Not so with the amnions, which are originally double, but which, their septum disappearing, become a single sac formed by a single chorion and a single amnion containing two fœtuses. The placenta, in this case, always forms a single mass. The two fœtal circulations intercommunicate through superficial and deep anastomoses, both venous and arterial. Nevertheless, this communication between the two circulations, although the

rule, is not always present. Sometimes two separate cords connect the placenta and the fœtuses, and sometimes, although more rarely, a single cord, proceeding from the placenta, soon divides into two branches, one for either fœtus. We find in the thesis of Chantreuil two curious cases, one of William Newman, the other of Soete. In the former, the cord of the first child was tied into a single knot, and surrounded a coil in the second cord, so that the latter was completely strangulated. In Soete's case the two cords, which were both very long, together formed, at about their middle, a perfect double knot. We refer to the article, "Labor in Twin Pregnancy," for remarks about the presentations and positions.

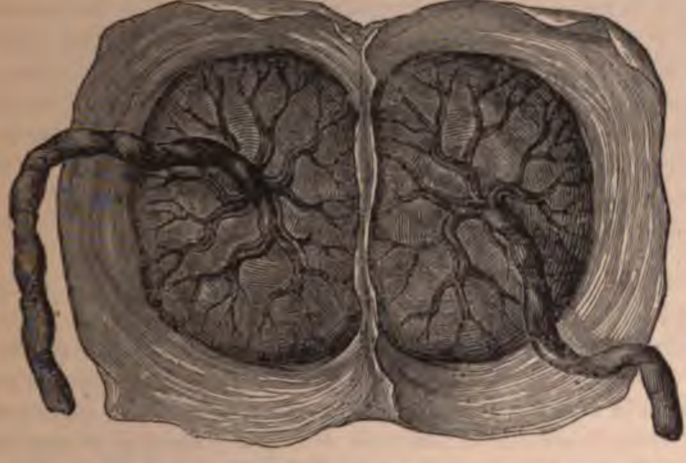


FIG. 185.—NORMAL DISPOSITION OF THE FŒTAL ANNEXES IN TWIN PREGNANCY.

Although the combined volume of the two fœtuses generally exceeds the volume and weight of a single mature fœtus, each is, separately considered, below the average, even when labor occurs at full term. However, it is not unusual to see twins quite as fully developed as single children. In two cases of twin pregnancy, seen by me in private practice, the children weighed as follows: In one case the combined weight of the two children, which were males, was a little over thirteen pounds. The first child weighed about seven and the second about six and one-half pounds. In the second case the two children weighed, together, fourteen and one-half pounds. The first child, the boy, much the larger, weighed nine pounds. The second, the girl, weighed five and one-half pounds. Difference, three and one-half pounds. In the first case the mother was a primipara, in the second a multipara. These cases are exceptional, but what is still rarer is the difference in the weight of the children. Generally one of them is much more fully developed than the other. Sometimes one child dies during the early months of intra-uterine life, while the other survives. This is explained by the independence of the two circulations. The dead child remains in utero and is expelled with its twin, but presents an appearance peculiar to itself. As the result of the absorption of its amniotic fluid, it undergoes a peculiar change, called mummification. Being compressed by its fellow, it grows flat, and becomes, aside from its color, which remains white, quite like certain well-known little ginger-bread images. At birth, it is found closely applied to the placenta, enclosed in what was once its fœtal sac. It is not very rare, in twin pregnancies, to see one fœtus well-formed, and the other presenting deformities or monstrosities. Cazeaux and Tarnier cite examples. These cases occur especially in premature deliveries and particularly in hydramnions. At times, the twins adhere to each other by means of different members, constituting the varieties designated by Geoffroy Saint-Hilaire by the names cephalopages, sternopages, xiphopages, ischiopages, pygopages, etc. In still other cases one germ being included within the other, one fœtus absorbs the other, which it partly surrounds. These are cases of fœtal inclusion. Finally, certain coccygeal fœtal tumors seem to be due to abortive twin pregnancies. We shall refer to these, in detail, in the chapter on "Monstrosities."

SIGNS AND DIAGNOSIS OF TWIN PREGNANCY.

The signs of twin pregnancy are either probable or certain. We shall first discuss the probable signs. The size and shape of the abdomen are peculiar in certain cases. There is generally, a greater abdominal development in twin pregnancies than would be expected in single pregnancies. Sometimes this is not true, and again, the size is such as at once to suggest multiple pregnancy. This is especially the case when the children are large, or the amniotic fluid very abundant. The size is, however, extremely variable. The shape of the abdomen is at times characteristic, and depends on the presentation. In a case cited by Herrgott, where the two heads occupied the fundus uteri, the womb resembled in shape the representation of a heart on playing-cards. Depaul and Guéniot call especial attention to one abdominal sign of twin pregnancy, viz., supra-pubic œdema. Localized above the pubes, this œdema presents a prominence, sometimes distinctly circumscribed, and sometimes diffuse. Occasionally, it forms in the hypogastrium a sort of sac or pocket, which stands out plainly from the abdominal wall. While this œdema occasionally occurs in single pregnancy, it is the rule in twin pregnancies. It is not a certain sign, but should always suggest multiple pregnancy and the propriety of searching for certain signs. Women often "feel life" at two points on opposite sides of the abdomen, and complain of an aggravation of all the discomforts of pregnancy, as heaviness, difficulty in walking, dyspnœa, varicose veins, hemorrhoids, etc. The certain signs are furnished by palpation, auscultation and vaginal touch.

1. *Palpation.*—The first sign obtained by palpation is exaggerated abdominal tension. Pinard emphasizes this sign, stating that the uterine wall, instead of presenting its usual suppleness and elasticity, is so tense as to give the uterus a peculiar resistance, which he compares to the resistance offered by the wall of a well-filled cyst. But the absolutely certain sign is the discovery, on palpation, of two heads or of two breeches, whether above or below, and recognizable by their respective characters. It is possible, later, to map out two backs or several small fœtal members, in different positions.

2. Vaginal touch will show the presence of one head in the pelvis, while cephalic ballottement will plainly reveal another at the fundus uteri, or in one iliac fossa. Pinard thus recognized a triple pregnancy. Depaul's ballottement is often obtained. Depaul has called attention to a sign already noted by Dugès and Lachapelle—the existence, during labor, of two consecutive bags of waters. Depaul attaches especial importance to auscultation. When there are two fœtuses, each fœtal heart has a different point of maximum intensity, and the hearts beat with a different rhythm. This is satisfactory proof of the presence of two fœtuses, provided that the difference between the number of pulsations be well-marked, from ten to sixteen at least. According to Depaul, the best way to obtain positive information is to have two practised observers simultaneously count the heart-sounds at their two points of maximum intensity, thus establishing or disproving their synchronism. But the diagnosis is sometimes very difficult, if, one fœtus being dead, only one heart beats, or if, owing to uterine contractions, to hydramnios, or excessive thickness of the abdominal walls, the fœtal parts can not be made out by palpation. We must, therefore, never rest content with one method of exploration, but if suspicion of multiple pregnancy be aroused, we should successively employ palpation, auscultation and vaginal touch. It is upon the *ensemble* of data thus obtained that the certain diagnosis of twin pregnancy is to be based. Although there are cases of twin pregnancy which may be easily diagnosticated, there are others presenting great difficulties, and we can not be too sure of the fact before making an announcement to the patient, which, for the majority of women, is a disagreeable surprise.

Although twin pregnancy does not make the prognosis bad, for either mother or children, it is still far from leaving the woman in so satisfactory a state as does single pregnancy. The large size of the abdomen, the marked œdema of the lower extremities, the mechanical interference with digestion, respiration and circulation, being more pronounced than in single pregnancies, induce so much fatigue and suffering, as to sometimes seriously impair the health. The patient must also undergo a double labor, as it were. As a result of the exaggerated abdominal distension she is exposed in some cases to uterine atony, resulting in hemorrhage. Besides, as we shall see, operations are often necessary in consequence of abnormal presentations. Besides these abnormal presentations, which expose the children to danger, there is another circumstance which unfavorably affects the prognosis for them—the fact that twin pregnancies rarely reach full term. Twin pregnancy also often coexists with hydramnion of one ovum. These facts show the necessity of reserve as to the prognosis in twin pregnancy.

Triple, Quadruple and Quintuple Pregnancies.—These cases are very exceptional. From the standpoint of anatomical circumstances relating to the ovum, we may find a combination of all the varieties described in our remarks on twin pregnancy. There may be three separate placentæ, two united placentæ, with one separate placenta; or three united placentæ, and consequently, three isolated fœtal sacs; two united sacs with one separate sac, one single fœtal sac, etc.

CHAPTER VI.

SPURIOUS PREGNANCY.

WE agree with Pajot who says "there is no such thing as spurious pregnancy." Pregnancy exists or it does not exist. Spurious pregnancies are only errors in diagnosis. We can not do better than to give here an analysis of the remarkable article of our master.

Pajot divides the errors into three principal classes. 1. Diagnosis of pregnancy when it does not exist; 2. Denial of existing pregnancy; 3. Confounding one kind of pregnancy with another.

1. *Diagnosis of Pregnancy when it does not Exist.*—The causes of this error are: *a.* A false interpretation of functional ailments; *b.* The existence of various abdominal and pelvic tumors; *c.* Changes in the cervix simulating those of pregnancy; *d.* Auscultatory signs similar to fœtal and uterine bruits; *e.* Deceptive sensations of movement, felt by the mother.

We have already recorded our belief that there is, in reality, only one certain sign of pregnancy, the fœtal heart-sounds. The three other signs, ballottement, either abdominal or vaginal, objective movements and fœtal souffle, are incontestably, also, certain signs, but the last does not always exist. Ballottement has been perceived in two or three conditions other than pregnancy. The active fœtal movements, plainly perceived by the obstetrician, are as certain as the heart-sounds, but one must always rely upon the latter. Unfortunately, in some cases the accoucheur is called after the death of the fœtus, when the diagnosis becomes very difficult.

2. *Failure to recognize existing Pregnancy.*—These mistakes, although less common than those of the former class, are yet not very rare, and many most justly distinguished physicians and surgeons have not always avoided them. This error may be due to ovarian cysts, fibroids and other tumors, ascites, dropsy of the amnion and versions or flexions. There is only one sure means of making a correct diagnosis, waiting until the fœtal heart-sounds appear. If the fœtus is dead, the diagnosis must be made by exclusion. Pajot insists upon the importance of what he terms the fœtal impulse in cases where the fœtus is alive. This sign is often perceptible to the ear before the appearance of the fœtal heart-sounds, and imparts to that organ a sensation at once tactile and auditory. We must, therefore, never fail to look for it.

3. *Mistaking Pregnancy of one Kind for some other Kind.*—That is to say, mistaking a uterine pregnancy for an extra-uterine, and *vice versâ*,

or a double pregnancy for a single one, and the reverse. The error, in the former case, is a grave one. In the article on Extra-uterine Pregnancy we shall see that this error has been committed, and shall then give the diagnostic points. We need not study the diagnosis of pregnancy in detail. For us, a single sign embraces all, viz., the heart-sounds. Let us cite the causes which have most frequently led to the commission of errors. These are, amenorrhœa, uterine affections, congestions, metritis, fibroids, hæmatometron or retention of menstrual fluid, ovarian tumors, ascites, tympanites, embonpoint and abdominal tumors. Ascites, fibroids, ovarian cysts, and abdominal tumors may co-exist with pregnancy, and thus render the diagnosis more difficult still. But there is one condition to which we must recur, death of the fœtus in utero, either before the certain signs were appreciable or afterward, if the accoucheur could not himself distinguish them. Sometimes the woman does not present herself for examination until these signs have disappeared, as a result of death of the fœtus. In these cases, the diagnosis is made with great difficulty. Auscultation is useless and palpation only gives imperfect sensations. On account of changes which the fœtus undergoes, the uterus, as a result of the reabsorption of the amniotic fluid, undergoes a retrogression more or less pronounced. The cervix resumes the characters it possessed before pregnancy began, and vaginal touch is insufficient to completely clear up the diagnosis, because of the absence of ballottement and of the sensation conveyed by contact with fœtal members. In these cases we hold that great importance attaches to two signs. One of these, to our mind, is absolutely certain, and, in one case, enabled us to surely establish the diagnosis of pregnancy. (Vide Hydramnion). The first of these signs, which is obtained by combined manipulation, is the development of the uterus, which seized between the finger introduced into the vagina, and the other hand applied to the abdominal wall, is thus often appreciable. The other sign, which enabled us to make a clear diagnosis in one case, was likewise observed by Budin in an analogous, although different case. This sign is the perception of a uterine contraction, induced by abdominal palpation, or gentle massage continued for some time. Under the influence of this contraction, the abdomen, which was before supple and yielding, became harder and more tense. This sign is, in our opinion, absolutely certain, for although, as some authors say, vesical contractions sometimes occur, these contractions disappear after evacuation of the bladder with a catheter, while a genuine uterine contraction will recur after withdrawal of the urine.

CHAPTER VII.

THE HYGIENE OF PREGNANCY.

LET us first establish the principle that pregnancy, being an absolutely physiological occurrence, the first law is not to change the habitual hygiene of patients. Moreover, since pregnancies are very variable, not only with different women, but even with the same woman, it is impossible to establish absolute rules of hygiene, and the attitude of the obstetrician in the majority of cases, should be absolutely expectant, but in other cases, his measures should be as active as possible. Besides the general hygienic rules applicable to all women, there are some indications, arising in the course of pregnancy, which must guide the physician. We limit our present remarks to general indications, reserving special indications for the chapter on diseases of pregnancy. In the great majority of cases, pregnancy follows its regular course, constituting a state intermediate between health and disease, if not of absolute health, and causing women only a little annoyance and malaise. Still, there are cases of pregnancy attended by complications, which, although different at the various stages, are none the less very painful, and demand the whole attention of the physician, who, it must be admitted, is often powerless to relieve. Without going into details which belong to a later chapter, we would here state that the greatest danger in pregnancy is that of abortion or premature delivery, which is always precipitated by uterine contractions. It is, therefore, the first duty of the physician to prevent these contractions, which occur normally during the whole progress of pregnancy, from surpassing physiological limits, and to render them harmless for both mother and child. The contractions tend particularly to transcend physiological limits at the time corresponding to the menstrual epoch. It is, thus, at this time, above all others, that the physician should interfere, employing measures which we consider heroic. These are absolute repose and laudanum enemata, containing twenty drops in ten ounces of water, given with a simple syringe and not with an irrigator, or a syringe with valves, so that the whole dose may be absorbed. The enemata may be repeated at intervals, which, according to the case, may vary from several hours to a number of days. The first advice which the physician should give his patients is to become accustomed to watch themselves, to learn to rest at the right time, and to take the opium themselves if necessary. No change should be made in ordinary cases, in habits, food, or exercise, and exaggerated precautions are to be avoided as much as insufficient ones. It is just as bad for pregnant women to remain stretched out on an invalid chair or in bed, as to undertake inordinately long walks or drives. We are great advocates of moderate exercise. We hold, then, that the pregnant woman should go out daily, either on foot or in a carriage, whichever she prefers. One sees many women who are fatigued by a carriage, but for whom walking is an agreeable and beneficial exercise. There are, on the other hand, many whom walking tires, and who get on admirably in a carriage, particularly if they choose macadamized streets on which jolting is avoided. The climbing of long flights of stairs must be absolutely forbidden. The rule must be to make the time passed out of doors the occasion for diversion and moderate exercise, never of fatigue. As is seen, we forbid neither dinners, concerts, nor theatres. Although we favor rides and drives, we do not permit journeys. The physician must be very circumspect in this particular. Beside the jolting of railroad travel, fatigue is incurred by the woman proportionate to the duration of the journey and the length of time during which her habits are changed. When we do permit travelling, we advise that the time of departure and of return be made to correspond with the mean time between two menstrual epochs. Since journeys are particularly dangerous when made early in pregnancy, they should only be permitted between four and a half or five months and seven and a half months from the time when fœtal movements come to bear witness to the fœtal vitality, up to the period of viability, when, if labor occurred, the case would not be one of abortion but of premature delivery. It seems to us a useful if not indispensable precaution to have the woman travel, if possible, stretched out in a sleeping car, or on the cushions of a carriage with good springs.

Only a word about clothing. The developing uterus fills the abdominal cavity more and more, and forces the woman to renounce, of her own accord, all tightly-fitting garments, and to adopt loose clothing, which gives better play to the thoracic and abdominal organs. Corsets should be absolutely proscribed. So-called pregnancy corsets, however loose they may be, still compress the breasts more or less, and, pressing on the diaphragm, displace the intestines, compress the liver and stomach, and thus often become the source of discomfort, which disappears when the corset is removed. We however recommend, almost without exception, the use of a light abdominal supporter, which adapts itself well to the shape of the abdomen, does not annoy the patient, and is, above all, essential for multiparæ. In these patients the abdominal walls, distended by preceding pregnancies, no longer afford, to the uterus, the support afforded by the abdominal parietes in primiparæ.

The linea alba often yields to the pressure, and the uterus falling forward by its own weight, gives to the abdomen the shape known as pendulous abdomen. This is more frequent in women with pelvic deformities, fibroids, etc. The supporter, besides sustaining the abdomen, affords it lateral support, and thus favors the accommodation of the long axis of the fœtus to that of the uterus. We have seen what *rôle* Pinard attributes to the abdominal walls, in producing this accommodation. We consider his ideas valuable, although not agreeing entirely with them. Who has not heard women express the desire "not to have their figure spoiled" by pregnancy! This disaster may, we believe, be best averted by wearing the abdominal supporter, which, by keeping the uterus vertical, and by sustaining the abdominal walls, is the best means of preventing them from being over-distended transversely. The constitution of the woman largely affects the result. Women naturally fleshy, blonde, of lymphatic temperament, and short in stature always retain a larger abdomen than thin, slender brunettes, of a nervous temperament, whose tissues possess greater elasticity. We would mention that, near the end of pregnancy, women are usually tormented by a sensation of weight and pressure in the pelvis, as if some object must be expelled, and that the desire to urinate recurs so often as to become almost unendurable, and to oblige the women to stay in doors. We have seen these difficulties yield to the influence of rest, followed by the application of a well-made supporter, slightly padded at the points intended to sustain the hypogastric and supra-pubic regions. Pregnant women, being more susceptible to cold, should so choose their garments as to avoid colds, thoracic and renal trouble, rheumatism and the resulting heart lesions. Thoracic affections, aside from their inherent danger, may, by further interference with the functions of the lungs and heart, and by the jarring of the uterus due to cough, excite abortions or premature deliveries. Pregnant women should particularly avoid coming in contact with cases of contagious disease (eruptive fevers, typhoid fever, sore throat, etc.), both in the interest of themselves and of the fœtus. Rules about diet are hard to give. In some women pregnancy develops an enormous appetite, and in others, appetite is absent or perverted. This we will recur to, under the heading, Diseases of Pregnancy. Among the many indications, thus furnished, one is very important. It is to make good for the mother the alimentary losses occasioned by the fœtus, by means of a nourishing and invigorating diet. For women who are well, and whose digestion is good, we advise meat-juice, tonics and Spanish wine for supper. If necessary, we increase the number of meals, making them less bountiful. These measures are especially adapted to young and feeble women. We are not strong advocates of ferruginous preparations. Besides being occasionally badly tolerated, they often produce obstinate constipation, to which the women are already only too much predisposed, both by habit and by pregnancy. Constipation is, indeed, habitual with pregnant women, and, in some, it attains alarming proportions. It must be antagonized by all possible means. Enemata constitute the most classical treatment but must often fail, and we advise the frequent repetition of mild laxatives, even from the first. A capital point is to keep the bowels open. We have seen a glass of cold water, on awakening, a cup of cold milk or, in women not accustomed to its use, a cup of coffee, meet the requirements of the case. If enemata are inefficient we advise mild purgatives, particularly castor oil, either taken in tea, coffee, lemon-juice or beer, or in capsules, magnesia, rhubarb, podophyllin, etc., or mineral waters. Drastics are to be avoided. In some cases diarrhœa, often very persistent, takes the place of constipation and is to be met with astringents, above all with sub-nitrate of bismuth. This is, however, rare, and it is more usual to see critical diarrhœas succeeded by intervals of constipation. If these diarrhœas do not last more than one or two days, they are not to be too much interfered with, as they often give the patients marked relief. We shall consider perversions of taste or longings among the diseases of pregnancy. Pregnant women are often tormented by toothache, and if they have carious teeth, they come to ask if they may safely have them extracted. We absolutely veto this course. Aside from the excitement which the little operation occasions, even under anæsthesia, we consider it useless. The pain is often purely neuralgic, and the proof is that it often persists in spite of the extraction of the tooth. For the rest, only absolutely necessary operations should be undertaken during pregnancy. Baths are to be recommended even from the beginning of utero-gestation, in spite of the current opinion that women should not bathe before the sixth or seventh month. Baths are useful, and should only be withheld from women subject to abortion. They should be short and not very warm (between 90° and 95°), and it is wise to take them at home, and to remain in bed for a half hour or an hour after the bath. We permit sea-baths, and cold baths and douches, but the sea-baths must be taken when the water is warm, they must only last five minutes at the longest, and must be taken, when the sea is calm, on a sandy beach. Cold baths should also be short, and no swimming is allowed. We do not advocate douches, unless the woman has been accustomed to hydrotherapeutics before pregnancy. Even then the douches must be administered by experienced persons. We prefer in this case cold ablutions in a bath-tub. We forbid, absolutely, lukewarm or cold injections and vaginal douches. Local treatment of uterine disease which antedated pregnancy, must be avoided or be limited to close surveillance or more careful precautions. The toilet is to be made as usual, with the simple precaution of using lukewarm water, rendered fragrant by cologne or *eau de toilette*. The breasts of women who intend to nurse their children require especial care. For a month before confinement the nipples are to be washed morning and evening with dilute brandy and water, tincture of arnica or tincture of benzoin, and the woman should endeavor to elongate the nipples by traction and friction, slight and repeated. These measures are particularly useful for women whose nipples are short and retracted. The delicate question of conjugal relations has been differently answered by various authors. Although intercourse has often caused abortion, it has in other cases been quite harmless. Its effect depends on the health of the woman. In the beginning of pregnancy, when there is marked malaise, the woman needs absolute repose, particularly at the time corresponding to the catamenial period. In the interval, the separation of the sexes is less necessary. Toward the end of pregnancy, intercourse becomes more and more difficult, and we have the statement of many women that, in many cases, premature rupture of the membranes had been brought about by conjugal relations. Although we, therefore, do not absolutely forbid intercourse, we recommend that it be indulged in only after careful consideration of the duration of pregnancy, and of the woman's state of health.

These are the general rules governing the hygiene of pregnancy. They are not absolute and vary as we shall see, according to the phenomena accompanying pregnancy, each of which may furnish particular indications.

CHAPTER VIII.

INTERROGATION AND EXAMINATION OF THE PREGNANT WOMAN.

THE interrogation of a pregnant woman must be conducted according to certain rules, which alone will permit the accoucheur to make the most complete diagnosis possible. The first questions relate to the diseases from which the pregnant woman suffered during infancy, to the present age, and to the age at which the woman began to walk. The last question is extremely important, and may furnish precious indications. Rickets causes arrested development and softening of the bones, which retard the infant's first steps, and leave in the lower limbs more or less marked traces of incurvation. These traces coincide almost always with pelvic contraction. In the woman, therefore, who began to walk late we should examine the lower extremities for evidences of rickets. At the same time, we should assure ourselves that the woman does not limp, has no spinal curvature, and was not subject to coxalgia in infancy. If these lesions exist, the woman must be made to understand that a more complete examination is necessary. The first duty of the accoucheur being to respect the modesty of his patients, his examination should only be made when absolutely indispensable, at as late a date as is compatible with safety, and in the presence of the mother or of the husband of the woman.

Passing to the subject of menstruation, the obstetrician inquires when the menses were first established, the conditions attendant upon the first menstruation, and upon the subsequent ones, such as the quantity, quality, duration, regularity, and accompanying phenomena. He then ascertains whether he is dealing with a primipara or with a multipara, and in the latter case, obtains information concerning earlier pregnancies and confinements, and about the date of the last confinement.

The next point is to ascertain the fact of existing pregnancy, and the stage of utero-gestation already reached. Passing the probable signs in review, the accoucheur will obtain information about the last menstruation, the nausea, digestive disturbances, etc. If pregnancy is far advanced, the date of quickening is to be ascertained. The history of any complications, such as œdema, varicose veins, hemorrhoids, digestive difficulties, constipation, circulatory or respiratory disturbances is to be taken. After these preliminaries, the physician proceeds to the direct examination of the patient, which should be made early if the woman has already had difficult labors, or if one suspects her pelvis of being deformed. He must never forget to examine the urine of all pregnant women, particularly of primiparæ, in order to seek for sugar, and particularly for albumin. Proceeding to the direct investigation, which should be made with the woman recumbent, he examines the lower limbs, the spine, the chest if necessary, and the breast, if the woman intends nursing, all with the least possible exposure. The examination of the abdomen will reveal its shape, volume, pigmentation, the striæ, the œdema of the abdominal walls, the state of the umbilicus, and possibly, supra-pubic œdema. Palpation will next convey exact information regarding the development of the uterus, the attitude of the fœtus, its volume, its presentation, its position, the quantity of amniotic fluid, the number of fœtuses, the mobility of the fœtus or of the fœtuses, abdominal ballottement, the greater or less engagement of the fœtal parts, the fœtal movements, the fœtal shock, the occasional fluctuation, etc. Auscultation will furnish data concerning the life of the child, its presentation and its position. It will confirm suspicions aroused by palpation, of possible multiple pregnancy, and will reveal the uterine souffle, the fœtal souffle when it exists, the bruit produced by fœtal movements, etc. Percussion will, in certain cases, aid in the recognition of ascites, ovarian cysts, putrefaction of the fœtus, etc.

If the data already obtained suffice, we may reserve the vaginal examination for another occasion. But, if one has the least doubt, he must not hesitate to overlook the natural repugnance of the patient, and must make her comprehend the necessity of the examination. The vaginal examination alone can show the state of the cervix, its softening, its situation, its length, its effacement, the state of its orifices, the degree of fœtal engagement, the presentation, the position, the condition of the inferior segment, the integrity of the membranes, the vaginal secretions, the state of the vagina, the shape of the pelvis, etc. The examination should always be done by progressive stages, and an absolutely complete examination should only be made, at the first visit, in cases of urgent necessity. Let the physician acquire, first his patients' confidence, accustom them to the measures he must adopt for their benefit, treat them with consideration, ask, at first, simple questions, and finish by asserting his authority. It is the accoucheur's duty to explain the necessity of more careful examinations, and then to undertake them with all the consideration, propriety and gentleness possible. Having availed himself of palpation, auscultation and vaginal touch, he ought to have obtained all the necessary information, and should not repeat his examination, particularly vaginal touch, until the last days of pregnancy. He will then encounter less resistance than before, because the women, being impatient to know when and how they are to be confined, will often request the examination which they so dreaded at the outset of pregnancy. If, however, the interests of mother or child demand the repetition of the examination, the accoucheur must himself request it, since it alone can prepare him for the assumption of entire responsibility.

PART IV.

LABOR.

CHAPTER I.

LABOR.—THE CAUSES OF LABOR.

IT might seem more logical to make the study of the pathology of pregnancy, that is of the diseases of pregnancy, follow that of normal pregnancy. But the pathology of pregnancy is epitomized in Abortion. Now, as abortion is only one variety of pathological labor, it is impossible to study it without first having acquired exact and detailed knowledge concerning the phenomena constituting normal, physiological parturition. We shall, therefore, first study normal labor, and then pass to the pathology of pregnancy, and of parturition.

Labor may be defined as the act by which the fœtus and its annexes are expelled from the maternal organism, whether the fœtus be developed in the uterus or without. It consists of two stages: 1. Labor proper, expulsion or extraction of the fœtus; 2. Expulsion or extraction of the placenta. We may classify labors, with Depaul, as spontaneous and as artificial.

Labor is spontaneous when it is terminated by nature's unaided efforts. It is artificial when the manual or instrumental intervention of the obstetrician is necessary. When labor occurs during the first seven months, before the fœtus is viable, it is known as a miscarriage, and may be either spontaneous or artificially induced. If parturition takes place at the seventh, at the eighth month or even in the ninth month, before full term, the child being viable, it is called premature labor, and may also be spontaneous or induced. If parturition occurs at the regular termination of pregnancy, it is known as labor at term. Labor taking place after expiration of the normal period of pregnancy is said to be retarded or delayed. Whether confinement be easy or difficult, simple or complicated and dangerous for the mother or for the child, the phenomena attending it are embraced under the generic term labor. A woman being confined is in labor, and the phenomena of parturition are, from their nature, physiological and mechanical. Before considering these phenomena, let us inquire into the causes of labor.

The causes of labor are determining and efficient. All authors now agree regarding the nature of the latter, but not of the former. We shall now pass in rapid review the opinions of different authors.

1. Determining Causes.

The earliest view attributed to the fœtus active participation in its expulsion. Fatigued and irritated, either by a special acridity of the amniotic fluid which irritated the skin, or by an over-accumulation of meconium in the bowel, by urine in the bladder, by high temperature in the uterine cavity, by the pressure of the head on the inferior segment, by increased pressure of the uterus, by obliteration of placental vessels, by inefficient respiration, and inadequate nourishment, or by contraction of the foramen of Botalius, of the ductus venosus or of the ductus arteriosus, the fœtus was supposed to exert force upon the uterine wall, and by its efforts, to seek to escape from the uterus. All these causes are hypothetical, for the fœtus often dies, in utero, and labor nevertheless occurs. On the contrary, when the fœtus dies, it becomes a foreign body, which the uterus endeavors to expel, and this is one of the most frequent causes of abortion and of premature delivery. The fœtus, therefore, plays no active part in labor. Those rare cases in which dead women have been delivered, even of living children, may be explained, as we shall see, without invoking the aid of the fœtus.

The determining causes were later sought for in conditions of the mother or of the ovum. It has been suggested that the ovum detached itself, at term, from the womb, as a ripe fruit from the tree, and Huwé, Naegelé, but particularly Simpson, followed by Schroeder, have given the following explanation: Toward the end of pregnancy a slow but progressive fatty degeneration of the serotina takes place. This destroys the organic connection previously existing between the ovum and the uterus. At all the points where this degeneration has progressed to a certain degree, the uterine nerves are irritated. But a certain sum total of uninterrupted stimulation is necessary to call reflex uterine contractions into play. When this necessary stimulation is produced, reflex contractions occur. But, as the contractions grow stronger, they separate the uterus and the fœtus to a greater extent, which, by augmented irritation of the nerves, induces contraction sufficiently strong to finally expel the ovum. All causes producing the necessary irritation will thus determine uterine labor pains, as the sound, injections and diseases of the ovum. According to Simpson, degeneration of the decidua commences at the fourth month. Langhans, Dohrn, de Sinety and Leopold do not believe that the degeneration begins so early. The above explanation is not received by Steinzel, who seeks the cause of labor in menstrual congestion, and attributes it to what he calls the nisus periodicus. Discomfort from catamenial congestion, however, is chiefly observed in the early months, and the irregularities of menstruation are of themselves sufficient to disprove this hypothesis. Lobstein and Chaussier first sought the cause of labor in the complete development of the uterus. They say that labor occurs when the muscular fibres of the uterus have reached their maximum growth. How, then, are abortions accounted for? Loder, Mauriceau and Scanzoni admit that, at the eighth month, the uterus has reached its maximum development. After that time, the uterine cavity is enlarged by distension. This can not go beyond a certain degree, hence the occurrence of labor. Brown-Séquard, Obernier, Kehrer, hold that the irritability of the uterus, progressively increasing, reaches its maximum at full term. Because of over-growth of the venous system, a considerable quantity of venous blood is held in the uterine walls. Now, this blood is heavily charged with carbonic acid, which is one of the most powerful stimuli to muscular action. Hence a first contraction, which expels the blood from the veins, and would thus put an end to contractions, if the pain it caused did not, in turn, excite the spinal cord. But, muscular action being necessarily intermittent, the fibres relax, a new afflux of blood ensues, and consequently, another contraction. Labor is the final result of the succession of these phenomena. Tyler Smith, modifying Steinzel's hypothesis, holds that true pains occur during the tenth menstrual epoch as the result of congestion, which is, thus, the determining cause of labor. Levret, Baudelocque and Desormeaux, returning to the theory of Lobstein and of Chaussier, hold that there is an antagonism between the fundus and cervix as regards development. The development is accomplished at the expense of the fibres of the fundus and body during six months. Later, the cervix participates actively, and, becoming widened from above downward, is effaced. Finally, the longitudinal fibres overpower the circular cervical fibrès, dilatation follows and labor takes place. Antoine Petit goes still farther. He believes that "the cervix is a store-house in which the uterus holds in reserve the muscular fibres, which, by their development, provide for uterine expansion during gestation. Everything is so measured, that when the fœtus is sufficiently developed to support the influence of external agents, all the cervical fibres have yielded, and the store is exhausted. But the child continues to grow, and, as he cannot do so without more space, the cavity in which he is contained is enlarged by the elongation of the uterine fibres. This elongation produces irritation, and contractions must follow, with the known results." The opinion of Antoine Petit has been negatived by the researches of Stolz, who showed in his thesis that the cervix does not change in length, during pregnancy, and that it is only effaced in the last days of gestation. This opinion was adopted, in a modified form, by Bandl, Martin and Braune. We have already considered this subject, *in extenso*, and need not revert to it here. Bandl and these authors hold that the cervical canal is replaced at last by a veritable cervico-uterine canal. So soon as this canal is formed by the softening of the cervix, and by the almost complete disappearance of the internal os, the ovum is brought into immediate contact with the external os, and irritating this orifice precipitates contractions.

At this point the theory formulated in 1819 by John Power, and admitted by Dubois, Pajot and Depaul, should be mentioned. Depaul, expressing the views of these authors, compares the expulsion of the fœtus to the expulsion of the urine and fæces, saying "The first fæcal matter which arrives in the rectum remains in the upper part of this portion of the bowel, producing no stimulation, no contraction and no tenesmus. But more fæcal matter is soon added to the pre-existing mass, which, being pushed onward, reaches the lower part of the rectum and is arrested by the sphincter. The fæces, in contact with the sphincter, engender, by reflex action, a desire to defecate and rectal contractions ensue. The sphincter at first resists, but its opposition being soon overcome by continued rectal contraction, it opens and the fæces escape. Micturition occurs in the same way. The determining cause of the expulsion of the human ovum is of the same nature." The ovum coming, at last, into contact with the uterine sphincter, excites uterine contractions, which finally produce cervical dilatation and the expulsion of the fœtus.

2. THE EFFICIENT CAUSES.

All authors agree that the efficient cause of labor is the contraction of the uterus, aided finally by the contractions of the abdominal muscles. This action of the abdominal muscles is sometimes absent, as in paraplegics, and in cases of complete uterine prolapse. In this case, the expulsion of the fœtus is due to unaided uterine efforts. We are unable to agree with Depaul in the opinion which seems to limit uterine action to the first stage of labor, the stage of dilatation, and we consider the contraction of the abdominal muscles almost indispensable in the second stage, or that of expulsion. The abdominal muscles *do* powerfully assist the uterus in the second stage, but, in many cases, their action is in abeyance, and yet the unaided uterine contractions suffice for the happy termination of labor.

CHAPTER II.

THE PRELIMINARY PHENOMENA OF LABOR.

IT is rare for labor to begin so suddenly and unexpectedly as to take women by surprise. Ordinarily, it is preceded by symptoms which have been called the preliminary phenomena of labor. The symptom which most impresses the patients is subsidence of the abdomen. Being due to the fœtal engagement and the subsequent descent of the inferior segment of the uterus, it occurs, of course, at a variable time before labor, according to the period of fœtal engagement, producing, when it comes, changes in the shape and size of the abdomen. As a result of this descent, the fundus uteri recedes from the ribs and the diaphragm, the respiration becomes more free and easy, digestion is more active, and the woman experiences a sense of well-being which may be likened to the calm before a storm. In other cases this abdominal subsidence augments the œdema of the lower extremities, and produces a feeling of pressure upon the intestine and the bladder, which results in frequent urination, and is often accompanied by leucorrhœa, which, causing the patients to feel moist, makes them believe that the waters are escaping. Sometimes the women are attacked twenty-four or forty-eight hours before confinement by profuse diarrhœa, which contrasts strongly with the pre-existing constipation.

At times, the patients are gay and lively, at other times sad and vaguely apprehensive, which latter feeling is encouraged by the occurrence of irregular pains, which, appearing at long intervals, and during several hours, finally cease, leaving the woman exhausted. The woman notices that her abdomen grows tense and hard. These contractions exist, it is true, during the entire course of pregnancy, but are, up to a late stage, painless and often imperceptible to the woman. If an examination be made at this time, we find, beside the thorough engagement of the fœtus, marked changes in the cervix, the chief of which is its effacement. In primiparæ the cervix forms a slightly projecting prominence, often a simple depression, either completely closed or hardly open, so that it is hard to distinguish it. In multiparæ the effacement is less pronounced, and the fœtus less deeply engaged, but the cervix is often widely dilated, and the os internum so large that the finger reaches the membranes, which, at the moment of contraction, bulge slightly outward. Millot has given the name of secret labor to these phenomena, but they are not constant, and it is not rare to see, particularly in primiparæ, the effacement of the cervix delayed until a few hours before labor. Parturition, having once begun, announces itself by two unfailing signs—regularly recurring pains, and cervical dilatation.

CHAPTER III.

LABOR.

THE phenomena of labor may be divided into two classes, physiological phenomena and mechanical phenomena. Tarnier and Chantreuil, agreeing with Kuneke, in this particular, admit a third series of phenomena, which they call plastic phenomena. We see no necessity for this class, as these plastic phenomena vary with the different kinds of labor, and are dependent on the presentation and position. Consisting in the changes of shape in the fœtal parts during their passage through the genital canal, they merit especial study with each presentation and position, but they do not form a separate class of phenomena, being concomitants of the mechanical phenomena. We, therefore, hold to the old classification, and proceed to successively describe the physiological and the mechanical phenomena of parturition.

The physiological phenomena are: 1. Contractions of the uterus and of the abdominal muscles. 2. The dilatation of the cervix. 3. Bloody discharges. 4. The formation of the bag of waters and its rupture. 5. The dilatation of the vulva and the distension of the perineum.

The mechanical phenomena are: The different movements executed by the fœtus, in its passage through the pelvi-genital canal.

PHYSIOLOGICAL PHENOMENA OF LABOR.

1. *Innervation of the Uterus; Uterine Contractions* (*Pains*).

We have stated that uterine contractions occur during the whole of pregnancy, but generally pass unperceived by the woman because they are painless. The uterine contractions of true parturition are, however, except in very rare cases, of a painful character, and the pain is so inseparably associated with the contraction, that the word pain has become synonymous with contraction, and is thus habitually employed by persons unacquainted with medical phraseology. The most striking feature of uterine contraction is its intermittence. The pains are clearly separated by distinct periods of repose, which, however, only possess a relative regularity. The pains, which at first are separated by intervals of a half hour, of a quarter of an hour, or of ten minutes, grow more frequent as labor advances, and the intervals separating them grow continually shorter, until they finally do not cover more than five minutes, three minutes or even less. The length of the intervals is inversely as the progress of labor. The pains, at first widely separated, succeed each other more rapidly during the stage of dilatation, and become almost continuous in the stage of expulsion. It is not rare, however, to see the uterus, after having contracted regularly for a time, enter, so to speak, upon a period of repose, perhaps of several hours' duration, after which, contracting more energetically, it may lead the labor to a rapid termination. At the same time that the pains grow more frequent, they generally become longer, but are, normally, always separated by intervals of repose.

The pains are involuntary. The will can neither originate nor suspend them, retard nor accelerate them. The emotions seem, however, to exert a certain influence upon them. The arrival of the accoucheur sometime causes such emotion, on the patient's part, as to retard, or even to momentarily suspend pains, which had before been very active and regular. The suspension is, however, generally brief, and the uterine contractions soon resume their normal character.

The pains produce marked modifications in the condition of the uterus. This organ hardens at the instant of contraction, and grows supple and yielding in the interval. It also changes its shape and position. It becomes more or less cylindrical, through the elongation of its antero-posterior diameter, and by the shortening of its transverse diameter. Schroeder states that even the longitudinal diameter is somewhat elongated by the pains. This elongation is said to occur particularly in longitudinal presentations, and is due, according to Schroeder and Ahlfeld, to fœtal extension, resulting from shortening of the transverse uterine diameter. This extension is incomplete before the rupture of the membranes, but manifests itself most clearly after the escape of the amniotic fluid. The uterus also changes in position, so that its fundus comes in contact with the anterior abdominal wall, and, repelling it, produces prominence of the abdomen. These changes may be appreciated by applying the hand to the abdomen, during a pain. The touch at this moment shows the uterine orifice more or less dilated, tense and rigid, and the amniotic sac simultaneously projecting through the os.

If the membranes are ruptured, the head is more closely applied to the cervix, and when the contractions subside, a little amniotic liquid escapes —not at the beginning of the pain, as Tarnier and Chantreuil erroneously state.

Uterine contractions have the character of contractions of smooth muscular fibres in general. Whether they proceed from fundus to cervix, as Spiegelberg and Schroeder think, or the reverse, as Kehrer believes, they soon become general. Partial uterine contractions are pathological, and will receive attention farther on.

The contractions are painful. This statement is true in a general way, but the pains are not of uniform intensity with all women, and they change, in character, at different stages of labor. In some cases, particularly in nervous women, the pains are very severe and are badly tolerated, while with others they are, incontestably, less violent. Some women have very energetic contractions, which are almost painless, and we can add two cases from personal observation to those cited by other writers. Both of my cases were young primiparæ aged 18, and hardly 17 years, respectively. In the younger girl, the same phenomenon was repeated in the second confinement, four years later. Again, some women complain more than others of the pains, exhausting themselves by incessant cries, while some control themselves better, and only manifest their pain by smothered exclamations, and by muscular efforts made coincidently with the contractions. If the hand be placed upon the abdomen, the uterine contraction may be observed to commence before the woman's suffering begins.

The pains are thus found to have three stages, one of inception or increase, one of maximum intensity and one of diminution. The increasing stage may be very short, and the same is true of the stage of greatest intensity, but the period of subsidence is relatively long. The whole pain lasts, generally, from sixty to eighty seconds. Feeble at first, the pains soon grow more severe, and, since they correspond to the cervical dilatation, they are called preparatory. They become expulsory and very violent at the end of parturition.

Although the pains grow more and more painful as labor approaches its termination, the final ones are better tolerated than those which correspond to the dilatation of the cervix. It is especially during the stage of dilatation that women manifest their sufferings by such cries and complaints that we have heard this period designated by an experienced mid-wife as the period of despair. In favorable cases the pains begin in the loins, next invade the lateral abdominal regions, and terminate anteriorly—thus embracing the whole pelvic region. In other cases, the pain is persistently localized in the lumbar region. Generally it prevails in that region until the head passes through the cervix, then giving place to expulsive pains, which last until delivery is accomplished. With premature rupture of the membranes, high position of the fœtus, rigidity of the cervix, deformities, or faulty presentations, the pains are often excruciating, and, unfortunately, intractable. Different explanations have been given to account for the pains, particularly for lumbar pains. Mattei attributes them to pressure of the uterus against the spinal column, and Beau to lumbo-abdominal neuralgia, analogous to that accompanying uterine affections. The causes of the pain vary, as Tarnier and Chantreuil remark, with the different stages of labor. Boivin is right in assuming that distension of the cervix is the chief agent in producing pain, but we shall also include, among the causes of pain, distension of the perineum, of the vagina, and of the anus, besides compression of uterine and pelvic nerves and of pelvic organs.

The influence of contractions upon the fœtus and the mother is extremely interesting. On auscultating the fœtus, at the moment of a pain, one hears the fœtal heart-beats grow slower and weaker as the contraction grows stronger, only to return to their normal condition when the pain subsides. In rare cases, the heart-sounds completely disappear. When this happens the interruption of the sounds is of very short duration, and corresponds to the maximum intensity of contraction. This slowing of the fœtal heart is attributed, by Schwartz, to an increase in intra-cardiac pressure, by Schultze to slight asphyxia of the fœtus, from placental compression, and by Kehrer to compression of the cranium and of the brain. The pains exert an accelerating influence upon the maternal pulse. The acceleration is augmented as the pain progresses, and gradually disappears with the subsidence of the contraction. Hohl, who counted the pulse during a pain which lasted two minutes, gives the following figures:

1st and 2d	quarter	minute	16	pulsations.
3d	"	"	20	"
4th	"	"	22	"
5th and 6th	"	"	24	"
7th	"	"	22	"
8th	"	"	18	"

As labor progresses the pulse becomes more rapid, so that it is as frequent, just before the expulsion of the fœtus, in the interval of the pains, as it was at the height of the pain in the early stages of labor. The character of the uterine contractions, as above described, will suffice for their differentiation from so-called false pains, which originate in organs other than the uterus, and are due to a pathological condition of the womb. We shall have occasion to revert to this subject. The uterine contractility sometimes persists, for a time, after the death of the mother, and thus allows a living fœtus to be expelled.

2. *Contraction of the Abdominal Muscles.*

The contraction of these muscles does not occur until the stage of expulsion. Originated by reflex action, it is, to a great extent, subject to the volition of the patient, who is thus enabled to materially aid in the expulsion of the fœtus. But, as before stated, this contraction is not indispensable for the happy termination of labor. The vagina, too, is the seat of contractions, which aid in the expulsion of the body of the fœtus, when the head has already escaped from the genital canal, but this contraction is particularly marked at the instant of delivery.

3. *Estimation of the Uterine Force.*

Efforts have been made to estimate the power of the uterine contractions. The uterus may be regarded as a hollow muscle, which, in order to expel its contents, must first establish an opening through which these contents may pass. The factors coöperating for the formation of this opening are: the effacement, the widening and softening of the cervix, the traction exerted upon the cervix by the uterine contractions, the increase of intra-uterine tension due to this traction, and, as a result, the tendency of the fluid contents of the womb to escape in the direction of least resistance, the cervical orifice. But the uterus also contains the fœtus, and thus exercises a duplex action: first, the rupture of the membranes and the cervical dilatation; and, secondly, the expulsion of the fœtus.

Different methods have been employed to measure the intensity of uterine action. Schatz made use of an apparatus called the Tocodynamometer. Poppel, Matthews Duncan, and Ribemont, tried to estimate the force necessary to rupture the membranes, believing that this would approximately represent the force of uterine contraction. Schatz holds that two forces are here at work. One, which he calls the force of general pressure, is the regular pressure which the contraction of a hollow muscle exerts upon its contents. The other, called the restitution of shape, is the force in virtue of which the uterus tends to resume its original form by means of contraction. This force, as a result of the diminution of the transverse diameter of the uterus, forces the fœtus into a position of extension, (Ahlfeld), and is supposed to act with special force upon the poles of the fœtus. Before the rupture of the membranes, the action of this force is always incomplete, but, after their rupture, the two forces simultaneously act, with their full power. Schatz introduces into the uterus, underneath the head, a rubber bag connected by a mercurial manometer, to Ludwig's Kymographe. The pressure to which the bag, moderately full of liquid, is subjected in the uterus, is indicated by the manometer, and recorded on the drum of the Kymographe in the form of a curve. Schatz thus found that the pressure exerted by the uterine tonicity and that of the abdominal muscles, the uterus being quiescent, is about the same and equal to 1¾ inches of mercury. The pressure at the end of labor of combined uterine and abdominal contractions, was from 3.1 inches to 9.7 inches. Consequently, the force necessary for the expulsion of the fœtus would vary from 7 to 55 pounds. Schatz's method is faulty in that it not only gives the measure of the uterine pressure, but that of all the coördinated forces of labor. Poullet, of Lyons, modified the experiments of Schatz, using two bags, one in the uterus, the other in the rectum, below the head, measuring, thus, both the total expulsive force, and at the same time the force of abdominal contractions. He obtained the power of the uterine contractions by subtracting the latter from the former. He called his apparatus the Tocographe.

Poppel found that an average force of five pounds is necessary to rupture membranes, the surface of which has a diameter of 1.9 inches. The average force required to expel the fœtus he found to vary from four to nineteen pounds.

Ribemont took up these experiments and concluded that, when the diameter of the membrane surface amounts to 3.9 inches, the average pressure necessary to produce rupture is 23 pounds.

Going still farther, investigators have studied the modifications in the individual uterine muscular fibres, during labor. When the uterus contracts down, after parturition, it is seen that its walls are notably thickened, and this thickening can only have been produced by a displacement of the muscular bundles such that, while some remain at the periphery, others are arranged beneath the first. This displacement is proportional to the shortening and thickening of the separate individual bundles. The thickening is not exclusively due to the cessation of the muscular elastic tension, but also to a state of active contraction, which persists after the stage of expulsion. Schatz denies that the separate fasciculi become shorter and thicker. He believes in a simple change of position. The tension of the uterine muscles, in labor, does not increase until the uterine walls grow thicker, and this tension does not increase more than one half during the course of parturition. Schroeder, therefore, admits the occurrence of shortening and thickening of the individual fasciculi in labor, but Schatz denies it.

4. *Dilatation of the Cervix.*

At the inception of labor, the cervix presents a projection, hardly perceptible in primiparæ, but a little more pronounced in multiparæ, as a result of the eversion of the os externum. The cervix is open in multiparæ, and generally closed in primiparæ. Under the influence of labor the cervix gradually opens, its orifice grows larger and larger, until it attains its maximum dimensions—that is, until it is wide enough to allow the passage of the fœtus. This is called the dilatation of the cervix. This phenomenon is differently explained by various authors. Some consider it essentially and exclusively due to uterine contraction—that is, they regard it as an active phenomenon. Others hold that the cervix passively yields to the pressure exerted on it by uterine contractions, at first transmitted through the amniotic fluid and the bag of waters, and later through the fœtus. We believe that the dilatation of the cervix is both active and passive. It is indisputable, indeed, that the chief agent in effecting cervical dilatation is uterine contraction, but we must not disregard the action of the amniotic sac and of the fœtus. For in cases where this action is wanting (premature rupture of the membranes, high position of fœtus), although the cervix dilates, it does so much less regularly, much more slowly, thus causing the woman more fatigue, and entailing notable prolongation of labor.

Let us study these different conditions in regular order. The fundus and body of the uterus are mainly composed of longitudinal fasciculi of fibres, beneath which is found a layer of transverse fibres. But these transverse fibres pass, as do the longitudinal ones, from one side of the womb to the other, thus making of this organ a muscular sac, in which longitudinal fibres predominate, the action of which will be exerted from above downward, and transversely, tending to particularly diminish the capacity of the contractile sac in a transverse and a longitudinal direction. The cervix, on the contrary, is chiefly composed of circular fibres, and the longitudinal fibres of the body are attached to the former. The first effect of the uterine contraction is, thus, to shorten these longitudinal fibres, and consequently to exert traction upon the cervical circular fibres—to act, in brief, upon the whole circumference of the orifice. A contest thus takes place between the longitudinal fibres and the circular cervical ones, and, as the former overcome the latter, the cervix must yield and open. As the intensity of uterine contraction is constantly increased, the cervix opens more and more. At the same time, the cervix tends to rise above the ovum, or above the fœtus, if the membranes have ruptured. The cervix thus tends simultaneously to dilate and to retract above the contents of the uterus. When the ovum is intact and the fœtus well engaged, owing to regularity of the presentation and favorable pelvic conformation, a new force is added to the uterine contraction, which, although not indispensable, since it is wanting in certain cases where dilatation still occurs, yet largely contributes to dilatation of the cervix. The ovum may, in fact, be considered as composed of two parts—one solid, compressible part, the fœtus, and one incompressible, the amniotic fluid. The uterus contracts simultaneously upon both. The solid part, being compressed, reduces its size as much as possible, so as to occupy the smallest possible space, but the incompressible liquid conveys the uterine pressure to the point where the uterus is least resisting, to the orifice of the cervix. Pushing the membranes before it, the liquid collects within these membranes, in the cervix, and the membranes, acting as a wedge, tend to enlarge the opening of the cervix with results proportionate to the force of uterine action, the resistance of the membranes, and the abundance of the contained fluid. After a time, the membranes rupture and the fœtal part then becomes engaged in the cervix, and, in its turn, acts as a wedge to finish the dilatation of the cervix. The cervix thus simultaneously dilates, both actively and passively. On the other hand, the presence of those membranes, and of a fœtal part in the cervix, irritates it, and consequently induces, by reflex action, increasingly intense uterine contractions. Thus, the rôle of the bag of waters is not entirely passive. The authors, therefore, who consider cervical dilatation as active, and not passive, are nearer the truth than those who regard this phenomenon as entirely passive. Since the dilatation occurs thus slowly and progressively, the cervix presents variable degrees of patulousness, at the different stages of labor, and pieces of money have been selected to illustrate these degrees comparatively. Thus, one says that the cervix is dilated to the size of a ten cent piece, a twenty-five cent piece, a fifty-cent piece and a silver dollar. When the maximum cervical dilatation has been reached, the borders of the cervix are continuous with the vaginal walls, the vagina and uterus form a single uninterrupted canal, and dilatation is said to be complete. Generally, the membranes do not rupture until dilatation is almost completed, and as the fœtal part, usually the head, impinges against the cervix, the latter forms a circle around it and the head is said to be "crowned." The head escapes from the cervix, and the latter, retracting more and more, becomes less and less accessible, the fœtus filling up the vagina. It

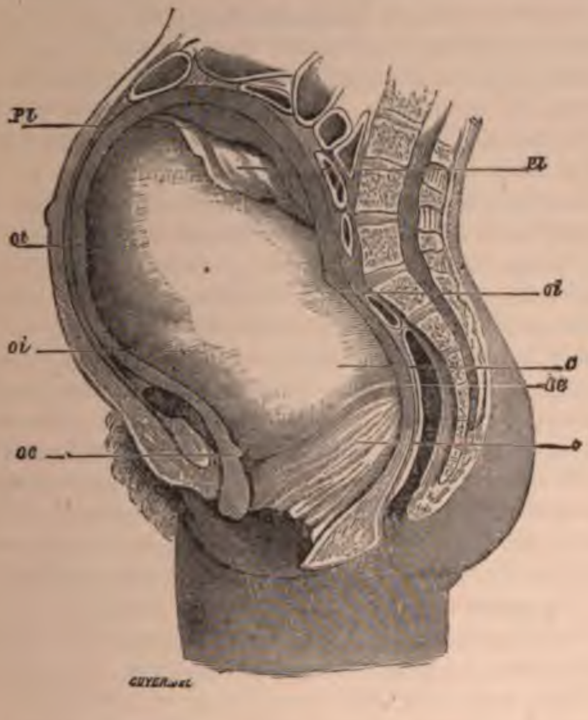


FIG. 186.—VERTICAL SECTION THROUGH THE GENITAL CANAL, SHOWING THE DILATATION OF THE CERVIX. (*Braun.*) *Pl*, Placenta. *ot*, Orifice of the tube. *oi*, Internal os. *C*, Cervix. *oe*, External os. *V*, Vagina.

would, therefore, seem as if, at a given moment, the cervix must completely disappear for two reasons: 1st, because it has become inaccessible; and, 2d, because its borders have become confounded with the vaginal walls. This, however, occurs only exceptionally, for the cervix never recedes sufficiently to be perfectly inaccessible, and the fusion of the margins of the cervical canal with the vaginal walls is never complete. In primiparæ, especially, the anterior lip is always more or less appreciable, at the level of the symphysis, between the latter and the head. The posterior lip usually escapes observation on account of the descent of the head. Tarnier found, in the frozen body of a woman who died at the Maternité, that, at the instant when the head was appearing at the vulva, the borders of the uterine orifice were below the symphysis, anteriorly, while they were, posteriorly, 1½ inches from the perineal margin.

The engagement, of itself alone, and even the appearance of the fœtus at the vulva, are not sure signs of complete dilatation, for there are, here, several causes of error which we cannot too much insist upon. The first is the engagement of the fœtus. We have several times seen students, and even physicians, consider dilatation complete when it had not even begun. The head pushes the inferior uterine segment before it, and the latter is sometimes so thinned that the sutures and fontanelles are almost as plainly felt as if uncovered. If one is not careful to carry his finger backward, he supposes dilatation to be finished before the cervix is fairly effaced. The second cause of error lies in the bulging of the bag of waters. Often-times, particularly with high presentations, the liquor amnii is very abundant in the lower segment, and, provided the membranes be resisting and yet elastic, they are largely distended, and one feels so large a bag of waters that he supposes dilatation complete. If, however, one carries the finger up to the base of the bag of waters, he feels that this base is only a pedicle circumscribed by the orifice of the cervix, dilatation being still far from complete. The cervix may be obliterated, and the lips agglutinated, as in cases reported by Depaul, Martin of Lyons and myself; the difficulty in finding the cervix may make one believe that dilatation is complete. The cervix may be displaced and almost inaccessible. Tarnier and Chantreuil mention the fact that often, particularly in primiparæ, the vagina forms a sort of circular fold, at its upper part. In the centre of this, the cervix, almost effaced, lies hidden, like the end of the water pipe at the bottom of a fountain, and the finger may pass over this, unawares, mistaking the vaginal fold for the cervix itself. All of these errors are committed, of course, only by unpractised fingers.

There is another phenomenon to which we ought to call attention: the so-called dilatability of the cervix. When the fœtal presentation is high, after rupture of the membranes, and the escape of the amniotic fluid, the cervix, having been almost completely dilated, recontracts somewhat, preserving, however, such suppleness and flaccidity that one may enlarge the os notably by digital pressure. Then we say that the cervix is dilatable, and the difference between dilatation and dilatability is, therefore, as follows: A cervix is completely dilated when its borders have come to be permanently continuous with the vaginal walls, being confounded, as it were, with them. A cervix is dilatable when, no matter what be its actual dilatation, it is sufficiently yielding to be artificially expanded so as to become continuous with the vaginal parietes. It is of great practical importance to fully recognize the dilatability of the cervix. It permits the intervention of the accoucheur if child or mother demand it, while, supposing that one waited for true dilatation to occur, the child might die and the mother be exposed, by the prolongation of labor, to puerperal diseases, which are more likely to occur when labor is protracted, when fatigue is great and traumatism considerable.

Charrier mentions a phenomenon rarely observed, to which he applies the name retrocession of labor. Its nature is the following: It sometimes happens, before the rupture of the membranes, that the cervix, already somewhat dilated, recontracts owing to interruption of the pains, but still retains a certain degree of dilatation. In the place of forming a simple ring, however, it forms a canal, .3 to .6 of an inch long, which the finger must pass through in order to reach the ovum. In this case something analogous to abortion takes place, and we shall return to the subject later.

Since the dilatation of the cervix is accomplished slowly and progressively, the orifice preserves its circular form throughout the labor. When, on the contrary, the cervix is the seat of cicatrices, and anatomical or pathological degeneration, since it is rare for the cervix to be uniformly diseased, the dilatation takes place at the expense of the healthy part of the cervix. Hence a variety of shapes of the orifice, which may become elliptical, triangular, rectangular, etc. While the shape of the orifice remains unchanged, the thickness of its borders varies. In primiparæ, dilatation is always slower than in multiparæ, and the cervix presents, according to the different stages, very different conditions. When dilatation begins, the cervix is very thin, represented only by the os externum, the lips of which are not thicker than a sheet of parchment, and are only separated from the head by the membranes, which are in almost immediate contact with the head. The head being, generally, very low down, there is very little liquid between the membranes and the head, and, at the moment of contraction, one feels a little sac of fluid shooting, as Madame Lachapelle used to say, through the os. The borders of the latter are so thin that a certain experience is necessary in finding the cervix. The sensation which one now obtains is peculiar: On passing the finger between the cervix and the membranes, the margins of the former give the sensation of a thick thread. As the bag of waters becomes more fully developed, and, particularly, when it bursts before complete dilatation of the cervix, and the head comes to press upon the cervix, the latter thickens, becomes tumefied and forms a cushion of greater or less thickness. If one now passes the finger over this dilated orifice he feels it to be composed of two parts, one external, thick, œdematous, tumefied, and one internal, thin, giving the sensation of a thread, such as we have described. Then, as labor progresses, the cervix grows thin again, without quite resuming its original thinness, presenting still a different appearance when the head becomes "crowned." At that time the anterior and lateral parts of the cervix remain thicker, while the posterior part is more thin. Then the head, descending still more, pushes before it the anterior cervical lip, which, being thus confined between the symphysis and the head, becomes swollen, and forms a cushion growing constantly thicker and thus offering an obstacle to the complete descent of the head. This obstacle may make itself felt for several hours, and it is only at the end of that time that the head succeeds in passing it, and the cervix becomes permanently inaccessible. It is the rule, when forceps are applied at the upper part of the pelvis, or at the superior strait, the head not having yet completely passed the os, to see this anterior cervical lip projecting at the vulva as a bluish prominence, having the thickness of a finger or even more. In multiparæ, on the contrary, the cervix is thicker, but dilatation is generally more regular, and it is not rare to see a single pain effect both complete dilatation of the cervix, and the passage of the head through this orifice. This œdema of the anterior lip is exceptional, and if this obstacle be absent, and the resistance of the perineum be slight, one often sees labor terminated in a few minutes by two to three pains. In primiparæ, the head, even after escaping from the cervical canal, often requires several hours to overcome the obstacle opposed by the anterior lip as well as the resistance of the vagina, perineum and vulva. Budin believes the resistance of the vulva to be insignificant, and thinks that the chief obstacle is the vaginal orifice.

The more energetic and regular the pains, the later the rupture of the membranes, the more normal the anatomy of the cervix, the more advantageous the fœtal position, and the more regular the conformation of the pelvis, the better and the quicker will dilatation occur. The head, in passing through the cervix, produces a laceration of its border, which, although of little importance in most cases, may extend to a certain height, and may even, in some instances, assume such proportions as to seriously endanger the woman's life. (*Vide* Rupture of the Uterus). The frequency of the position L. O. A. explains why this laceration occurs, ordinarily, on the left. Repeated at each confinement, these lacerations impart to the cervices of multiparæ their characteristic aspect, as the result of cicatrization, and of the subsequent changes in the cervical tissues.

5. *Leucorrhœa.*

The vaginal and cervical glands are considerably hypertrophied in pregnancy, and their secretions notably augmented. This gives rise to leucorrhœa, which increases in proportion as pregnancy advances. (*Vide* Chapter concerning Anatomical Modifications of the Genital Organs). The thick, viscid mucus, secreted by the cervical glands, accumulates in the cervix, constituting the so-called cervical gelatinous plug. As soon as the cervix is definitively obliterated, and when dilatation is about to begin, the organ, opening, allows the mucous plug to escape, which, mixed with the vaginal secretions, issues from the vulva in the form of a yellowish fluid containing more or less blood. In certain cases the quantity of blood is sufficient to stain the woman's linen. This is the so-called "show." Tarnier holds that a certain quantity of amniotic fluid often mingles with this discharge, having transuded through the still unruptured membranes. The experiments upon which Tarnier bases his deductions regarding the transudation of amniotic fluid, having been made with membranes obtained after delivery, and under conditions quite different from the physiological ones, do not seem conclusive to us. It seems much more natural, to us, to refer the moisture of the vagina, during labor, to the vaginal secretions. In Tarnier's experiments, indeed, the pressure exerted on the membranes was continuous, while, in labor, the pressure is short and intermittent, since it results from uterine contractions.

6. *The Bag of Waters.—Rupture of the Membranes.*

The bag of waters consists of that part of the membranes which, distented by the amniotic fluid, projects through the more or less dilated cervix. It forms as soon as the pains have sufficiently dilated the cervix to allow the membranes to become engaged in its orifice. Its enlargement is, in general, dependent upon the degree of cervical dilatation. Tense, resisting, prominent during the pain, which forces more and more of the amniotic fluid into its cavity, the bag of waters is, during the intervals of contraction, flaccid and soft. It may then be indented by the finger, which thus takes cognizance of the presentation, and, often, of the position. The bag of waters is, as Depaul remarks, essentially temporary, even as the cause which produces it, and only becomes permanent in the pathological cases where the uterine contractility has assumed the same character. The shape of the bag of waters is not constant, depending not only on the shape of the cervix, but upon the variety of the presentation and upon the extent to which engagement has taken place. The bag of waters is generally hemispherical, and its size is greater in proportion as the presentation is abnormal. It is, thus, small in head presentations, and is more voluminous in less favorable presentations and in cases of delayed engagement. Spherical or hemispherical in head presentations, it is often oval in presentations of the trunk, and in obliquity of the uterus. In pelvic presentations it is cylindrical. The bag sometime resembles an ampulla, compressed and pediculated, at its base, by the undilated cervix. The bag is double under two conditions. The usual condition is in cases of twin pregnancy. The other, more rare, has been reported by Campbell, and we have seen two examples. The obstetrician himself ruptures the membranes, or witnesses their rupture, and, nevertheless, a second bag of waters is formed, after a time. This bag either bursts spontaneously or the accoucheur is forced to rupture it. The practical inferences to be drawn from the shape of the bag of waters suggest themselves. Every time that the physician encounters a voluminous bag of waters he must, above all, make sure of the diagnosis, and, if it is abnormal, as is often the case, he should seek to prevent the rupture of the membranes, so as to retain the largest possible quantity of amniotic fluid, the presence of which frequently facilitates the intervention of the accoucheur (Version). Certain German obstetricians, in order to prevent the rupture of the membranes in these cases, do not hesitate to introduce a bag of rubber distended with water (Colpeurynter of Braun) into the vagina, to support the bag of waters and to avoid its rupture. In the article on the "Placenta" we stated that, in certain cases, the umbilical vessels ramify on the membranes (*insertio velamentosa*). In these cases spontaneous or artificial rupture exposes the fœtus to a hemorrhage which may be mortal if the rupture involves one of these vessels.

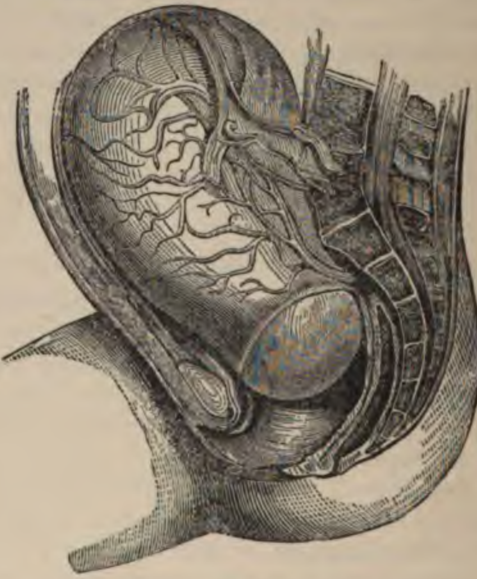


Fig. 187.—The Bag of Waters.

Generally, when the cervix has dilated to a certain variable extent, the bag of waters, being only imperfectly supported by the cervix, and no longer having sufficient strength to resist the pressure made upon it by the amniotic fluid, under the influence of uterine contraction, yields to the pressure, and the liquor amnii escapes. But, often, this rupture is retarded by two very different causes. In one case the membranes, very tough and thick, resist on this account. In the other case, although apparently thinner and weaker, they seem to possess a peculiar elasticity which causes them to grow thinner as they are distended. In some exceptional cases one sees the membranes propelled to the vulva, in front of the head, at the moment of its liberation. The infant is, thus, born "with a caul," formed by a part of the membranes, which are torn at the moment of the expulsion of the head. At other times the membranes do not rupture, and the ovum is expelled entire. Although certain authors have reported cases in which the ovum escaped in this way at term, we consider them very exceptional, and we find, on consulting the records of the clinique, where five or six analogous cases are reported, that the fœtuses were from five to seven months old, and that some of them had been dead for a certain time. Although delayed rupture of the membranes is rare, it is very common to see cases of premature laceration, so that the time of the rupture is variable. Ordinarily, this rupture coincides with the first expulsive pains, but it is not rare to see it occur from twelve to twenty-four hours before labor begins. Some rare cases, in which labor was delayed much longer, after the rupture, have been reported. Bailly and Garipuy have seen an interval of thirteen days, and another of thirteen and one half days, between the rupture and the beginning of parturition. The interval in one of our own cases was twelve days and in another fourteen days. Chantreuil's two cases had intervals of twelve and twenty-seven days, respectively. Campbell cites an interval of seventeen days. We have recently seen a case in which the interval was forty-four days. The most exceptional cases are those of Poullet, in which the expulsion of the living fœtus took place, in one instance six weeks, and, in another, five weeks after rupture of the membranes. We are inclined to consider these cases examples of hydrorrhœa, rather than of premature rupture of the membranes. Generally of little importance, the premature rupture of the membranes may, if the child be dead, have much more serious results. Allowing the air to reach the cavity of the uterus, rupture favors putrefaction of the fœtus, and, provided that expulsion be delayed, the development of putrid gases in the uterus, as a result of changes in the fœtus, becomes a source of great danger to the mother. We saw one such case when assisting at the clinique. The patient died of putrid infection.

Ribemont has proved that rupture may occur in two ways: The membranes rupture simultaneously, or the decidua and the chorion yield first and the amnion afterward. Hence the different forms of rupture. The accompanying figure, borrowed from him, shows these different varieties.

Generally, when spontaneous rupture of the membranes occurs, labor is accelerated from that moment, and Churchill has noted that, out of 812 cases, labor occurred in 658 cases within four hours after the rupture, and, in the other 154 cases, the time varied between 6 and 150 hours. There is a great difference, in this particular, between primiparæ and multiparæ. In primiparæ, the average interval between rupture of the membrane and labor is from two to four hours, but it is not so in multiparæ. In the latter the usual interval is one to two hours, but labor often occurs in half an hour, or an hour, at the longest. Often, indeed, the interval is much shorter, and we have frequently seen dilatation of the cervix occur after one to two pains, and the expulsion of the infant ensue in a few minutes. The manner in which the amniotic fluid escapes depends on the quantity of fluid in the bag and on the point of rupture. If the bag is large, and if the rupture occurs, as it generally does, at the cervix, the liquid escapes with a gush. The patient feels herself moistened, and sometimes she feels the rupture or tear. It is especially in those cases which coincide with abnormal presentations, or high positions, that one sees prolapse of the cord, or of fœtal parts. If, on the other hand, the bag is small and flat, while the fœtal part is well engaged, or, if the rupture occurs at a variable distance above the cervix, only a few drops or spoons-full of liquid escape. It is not rare to see, in these cases, a second bag form later, at the os, and spontaneously or artificially rupture. In such a case it suffices to raise the head, or to pass the finger between the head and the cervix, to make a larger amount of liquid escape. When deep engagement has occurred, the fœtus plugs the os, and the liquid escapes only intermittently. Tarnier and Chantreuil say that, in these

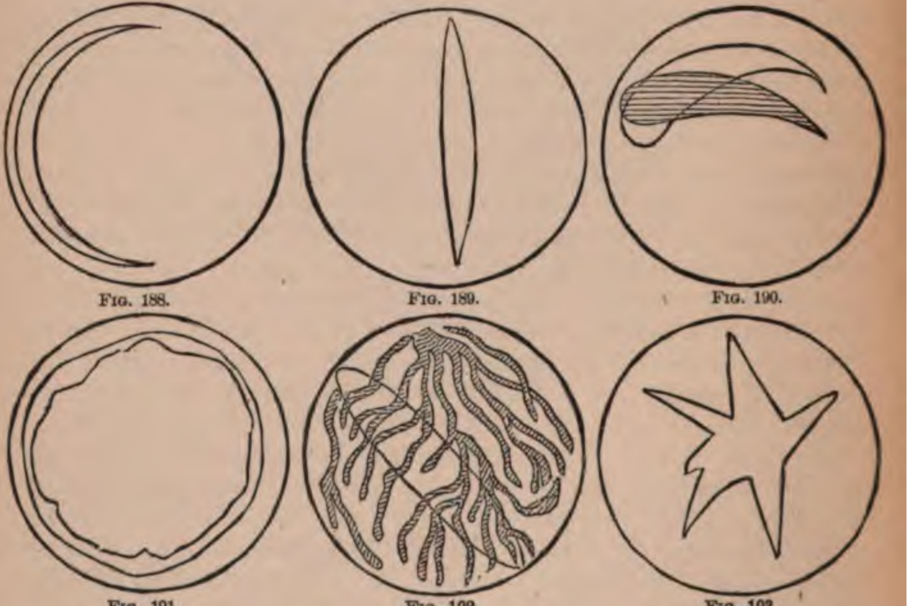


FIG. 188. FIG. 189. FIG. 190.

FIG. 191. FIG. 192. FIG. 193.

RUPTURE OF THE MEMBRANES. (*Ribemont.*)

cases, the escape occurs at the beginning of the pains, but we think that it is at the end. The first effect of the pain is certainly to drive the liquid toward the cervix, but the fœtus being more closely approximated to the cervix by the contraction, the liquid is unable to escape, and it is not until the stage of subsidence of the pain—that is, until the contact between the fœtus and the cervix ceases to be close—that more liquid can escape. We will see, in a later chapter, the indications for artificial rupture of the membranes, and the manner of performing this operation. It is generally easy to assure one's self that the membranes are ruptured, but we are sometimes in doubt. It has been suggested to examine during the pain, to assure ourselves that the bag of waters grows tense. It has been stated that, when the membranes are applied to the head, the sensation which we experience is that of a polished, smooth surface, and that, in the opposite event, we feel the hair and the folds of the cranial tissues. These signs seem insufficient to us, and there is one which we consider much more certain, and which enables us to avoid errors which may be of danger for the child. This is to introduce the finger as high as possible between the head and the cervix. If the membranes are intact, no change occurs. If the membranes are ruptured, the finger, by slightly displacing the head, will make an empty space through which the liquid can escape, thus reaching the palm of the hand and leaving no doubt about the rupture.

The examination of the liquor amnii furnishes valuable information about the condition of the child. So long as the child is well, the liquid preserves its normal character, but if the child is ailing, meconium escapes, which colors the liquid a more or less dark yellowish green. Auscultation will confirm or remove doubts, for this escape of meconium occurs normally and without danger to the child in pelvic presentations. If, however, the child has been dead for a certain time, the maceration which it undergoes in the sac formed of the membranes is accompanied by dermal vesicles filled with a sanguinolent fluid, or even with blood. These vesicles, rupturing, allow their contents to escape into the amniotic fluid, which they color a more or less dark red, according to the time when the death of the fœtus took place. The liquor amnii at the same time grows inspissated and muddy.

7. *The Dilatation of the Vagina and of the Perineum.*

At the beginning of labor the vagina, which is already shortened by the engagement of the fœtus, is farther dilated and enlarged by the descent of the latter, at the expense of its length. It does not, however, yield so easily in its lower portion and particularly not at its anterior extremity. Budin's researches, already described in our remarks on the anatomy of the vagina and hymen, show that, particularly in primiparæ, the vaginal orifice may resist several hours, and that this resistance, attributed up to the present time to the perineum, must, in the main, be referred to this vaginal orifice, since the vulva offers but little resistance when the ostium vaginæ is once overcome. We hold to Budin's opinion, and have often seen, in primiparæ of course, this vaginal orifice pushed through the vulva and projecting as a little livid prominence, .19 inches broad. In this case the head only escapes after little lacerations have occurred in the projecting vaginal fold. In one case, Budin succeeded in bringing a labor, which was protracted without other cause, to a close by dividing the vaginal orifice, the vulva and perineum being left untouched. But the resistance of the perineum also plays an important part. Its dimensions in a state of repose, as compared with those it attains at the end of labor, when the head is being expelled, prove the above statement. The perineum, which normally is only from .39 to ½ an inch long, at the outside, often attains a length of seven inches, and this distension is only slowly produced by the incessant pressure of the head. At each pain, indeed, the head, having reached the pelvic floor, presses upon the perineum, which it causes to project more and more, while it pushes out the anus, which opens and reveals a certain area of the rectal mucous membrane. Then, as the contraction ceases, the perineum retracts, in virtue of its elasticity, and the head, which was appearing at the vulva, disappears within the vagina to reappear with the next pain. At the end of a variable time, this head, which has appeared and disappeared several times, each time showing a greater extent of its surface, becomes fixed under the symphysis. It recedes no more, and the over-distended perineum forms only a kind of thin, bluish membrane which seems ready to rupture at the slightest effort. The head rests thus immovable for some instants, and finally, a last contraction expels it, and the perineum glides over it from before backward, passing successively over the large fontanelle, the forehead and the face of the child. At this moment the perineum is, ordinarily, torn. Hence the indispensable precautions which we will study, in detail, when we come to the management of labor.

CHAPTER IV.

THE MECHANICAL PHENOMENA OF LABOR.

THE term mechanical phenomena or mechanism of labor, designates the *ensemble* of the movements imparted to the fœtus by the uterine contractions, and which are intended to facilitate the expulsion of the fœtus from the maternal parts. These different movements are described by accoucheurs under the heading "periods of labor," five of which are usually recognized. We make, with Tarnier and Chantreuil, a sixth period, which is the second part of the fifth period of other authors. Before entering upon the details of the mechanism of labor, let us, with Pajot, admit that: "All labors, from a mechanical standpoint, are subject to the same law, and that there is really only one mechanism of labor, no matter what the presentation or the position, provided only that expulsion occur spontaneously, *i.e.*, without the intervention of art, and at term, as abortions do not result in regular expulsion." In all labors, therefore, there are six periods. In the first period the fœtus, under the influence of uterine pressure, will tend to accommodate its form to that of the uterus, and to that of the canal through which it must pass, and must, therefore, reduce its volume. This period is called the first period, or period of moulding. In the second period, the fœtus becomes engaged, and descends into the pelvis. Thus the second period is that of engagement or of descent. In the third period the fœtus executes a movement of rotation, which brings the part which is to engage to the front, and arranges its long axis antero-posteriorly, in the conjugate diameter. Hence, the third period is that of internal rotation. In the fourth period, the fœtal part in question frees itself, and emerges from the genital canal by describing the arc of a circle below and in front of the symphysis, the lower border of which may be regarded as the central point. This fourth period is that of expulsion. In the fifth period, the fœtal part experiences a movement of external rotation, corresponding to a movement of internal rotation performed by that part of the fœtus still remaining in the genital canal. This is followed by the expulsion of the rest of the fœtus, by a process identical with that of the fourth period. This is Tarnier's sixth period. So the fifth period is one of external rotation, and the sixth that of expulsion of the rest of the fœtus. These periods are not absolutely identical in all presentations and positions of the fœtus, but we will encounter them in all labors, whatever the presentation and the position. Let us pass in review the different presentations and positions.

We have stated that the fœtus may present by its cephalic extremity, flexed or extended (vertex or face), by the pelvic extremity, completed or incomplete (breech or feet), and by the trunk (right or left shoulder), and that each of these presentations has two cardinal positions (right and left), each of these positions presenting the varieties anterior, transverse or posterior. Let us study the mechanism of labor in these different presentations and positions. We will then see Pajot's absolute law justified by the facts.

VERTEX PRESENTATIONS.

We have already seen the causes of vertex presentations, and have studied the positions of the fœtus, in detail, in considering abdominal palpation. We are thus, at once, brought to the diagnosis of vertex presentations, which is made by palpation, auscultation and vaginal touch, and should be made before labor, during labor, both before and after the rupture of the membranes.

a. *Before Labor—Palpation.*—Palpation permits us to discover, at the lower part of the abdomen, a hard, round, smooth, prominent object, and at the upper part, another body broader, equally prominent, but less round and hard, beside which we recognize little mobile objects which may be displaced by the fingers, and which are the inferior fœtal extremities. On one side of the uterus or the other one feels a resisting, expanded mass, which connects the upper and lower tumor. This mass is the back.

Auscultation.—The fœtal heart-beats are heard below the line which divides the uterus into two equal parts.

Vaginal Touch.—By this means one feels a hard, round, prominent body, more or less engaged, which sometimes imparts a sensation like parchment to the finger, or upon which we may feel, when the inferior segment is thin, the sutures and the fontanelles. In front of this tumor, at a variable height and generally on the left, one feels the little eminence and depression formed by the more or less completely effaced cervix.

b. *During Labor.*—The signs furnished by palpation and auscultation are the same, but palpation is more difficult on account of the uterine contractions. These methods of examination must, therefore, be employed in the interval between the pains. Vaginal touch furnishes different information according as it is practised before or after rupture of the membranes. Before the rupture of the membranes, vaginal touch varies according as it is employed during the pains or during the intervals. If we palpate during the pains, we feel the os more or less dilated, more or less thick, more or less rigid, and occupying it, the tense, projecting bag of waters. Behind the bag of waters we feel the head, more or less separated from it, according to the quantity of the liquor amnii. The signs thus obtained are generally not very plain. The interval between the pains is, therefore, the time for palpation. At this time we feel the head, which is recognized by the sutures and the fontanelles, and which clears up all doubts regarding the nature of the presentation. If the head is mobile, not having engaged, it is a little less easy to recognize. Then it is well to depress the hypogastrium with the left hand, in order to make the head more accessible, and to bring out the sutures and the fontanelles more plainly.

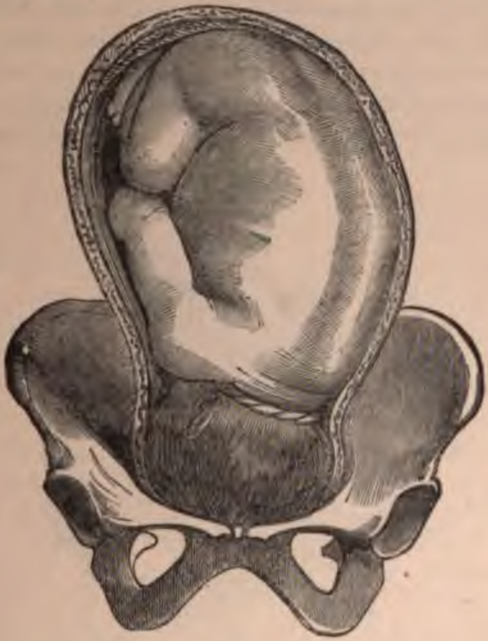


FIG. 194.—PRESENTATION OF THE VERTEX. (O.L.A.)

After Rupture of the Membranes.—If the membranes have just ruptured the diagnosis is very easy. Nothing intervenes between the head and the finger, which comes into contact with the sutures and the fontanelles, and takes cognizance of their shape, extent and direction, thus simultaneously establishing the diagnosis of the presentation and of the position. If the membranes have been long ruptured, however, the diagnosis may be more difficult. Upon that part of the head which is over the pelvic brim, and, consequently, on the accessible part of the head, there is formed an œdematous swelling of the scalp, called the caput succedaneum, which, masking the bones, renders the perception of the sutures and of the fontanelles difficult and paves the way for errors. (Fig. 195). In this case the finger must be pushed higher, beyond this projection. It will thus discover the sutures and the fontanelles, which prove that the vertex is presenting. If need be, whenever the presentation is above the brim, we must not hesitate to carry the finger as far up as possible. This facilitates the diagnosis of a possibly coexisting prolapse of the cord or of a fœtal extremity. When the fœtus is dead, and has been macerated for a certain time, the head loses some of its characteristic features. The tissues uniting the bones have lost their solidity, and allow the bones to play upon each other, which gives a characteristic crepitation.

Having made out the presentation, we must next diagnosticate the position. Vertex presentations have two cardinal positions, viz., the right and left positions of the occiput. There may be three varieties of either position, viz., anterior, transverse or posterior. The transverse position is rare and is only a deviation from the anterior or posterior position.

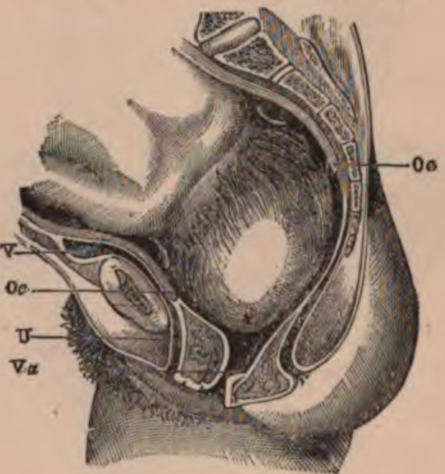


FIG. 195.—FORMATION OF THE CAPUT SUCCEDANEUM. *V*, Bladder. *Oe*, External os. *U*, Urethra. *Va*, Vagina. *X*, Caput succedaneum. (O.L.A.)

The diagnosis of the position O.L.A. is made by the aid of palpation and auscultation. Vaginal touch furnishes only unreliable information, in the majority of cases. By palpation we ascertain the character of the vertex presentation. If we endeavor to seize the head between the two hands, at the superior strait, we find that one hand penetrates farther than the hand placed on the opposite side. The flexion of the head, involving, as it does, the depression of the occiput, tends to elevate the forehead on the opposite side, and since, in the position O.L.A., the occiput is on the left, the hand will be arrested on the right side, *i.e.*, on the side of the forehead. Now, since the forehead corresponds to the anterior surface of the fœtus, the back will, of necessity, be on the opposite side. The diagnosis of the cardinal position O.I.L. is thus already made. It now remains to ascertain whether it be anterior or posterior. Palpating the left side of the abdomen, one will encounter there, in front and on the left, a resisting surface which diminishes from before backward. In multiparæ the sensation is sometimes less clear, for the back, as a result of the uterine obliquity, cuts the abdominal wall along a diagonal line. As Pinard remarks, a straight line drawn from the right flank to the left iliac fossa fairly represents the direction of the resisting surface.

a. *Auscultation.*—The heart-sounds are heard below the horizontal line, which divides the uterus into two equal parts, in front; on the left and below, according to Depaul, along a line uniting the left ilio-pectineal eminence and the umbilicus, but, according to Chantreuil and Tarnier, along a line passing between the umbilicus and the left anterior superior spinous process. Vaginal touch is rarely useful in recognizing the position before labor.

b. *During Labor.*—The same signs on palpation and on auscultation. On vaginal examination the whole difficulty lies in the recognition of the sutures and of the fontanelles, and this will be easier if the examination be made after rupture of the membranes, before the formation of the caput succedaneum, *i.e.*, soon after the rupture and between the pains. The finger is made to pass over all of the head which is accessible, until it encounters a furrow limited by bony borders. This is the sagittal suture. In order to be sure that it is the sagittal suture we must reach the anterior and posterior fontanelles. The anterior fontanelle may be recognized by its quadrangular shape, by its size, and by the fact that a suture terminates at each one of its angles. The posterior fontanelle is known by its triangular shape, its smaller size and its three angles, at each of which a suture ends. Having recognized the sagittal suture, we must discover its direction. Nothing is easier, after the recognition of one of the fontanelles. If, for example, we find the anterior fontanelle behind and on the right, it suffices to follow the sagittal suture away from this fontanelle, and we will find this suture crossing the pelvis in the left oblique diameter, and ending at the posterior fontanelle, which will be in front and to the left. If, however, we feel the posterior fontanelle in front and at the left, we will feel the sagittal suture following the left oblique diameter, from before backward, to the anterior fontanelle, which is placed behind and on the right. Since the posterior fontanelle corresponds to the occiput, it will necessarily show the position of the latter. Unfortunately, the fontanelles are not always very easy of recognition. Sometimes the anterior fontanelle is very small, as a result of the ossification of the head, and may be confounded with the posterior fontanelle. We must, therefore, carefully count the sutures ending at a given fontanelle. In other cases we only find one fontanelle. If its characters are well-marked, the diagnosis is not difficult. Since the sagittal suture is the longest of all the sutures, and always ends at the other fontanelle, it will suffice to take cognizance of the direction which it follows to establish the diagnosis, provided that the situation of the fontanelle, which is felt, be known. Again, the posterior fontanelle may be very broad. In this case the three sutures will serve to distinguish it. In certain cases there are supplementary fontanelles. Being situated, almost always on the sagittal suture, the extent of which they seem to limit, they may momentarily lead us into error, but we can always distinguish them from the true fontanelles, by the fact that, being due to failure of ossification, they are generally the termini of only two sutures, the two prolongations of the sagittal suture. Nevertheless, in certain cases, a sort of suture, starting from one of their borders, ends near the parietal bone, but this rudimentary suture is always short. It is necessary, moreover, to explore the whole length of the sagittal suture in these cases, and we find farther along the anterior fontanelle or the posterior fontanelle with its typical characters. Another cause of difficulty is a large caput succedaneum which hides the sutures and fontanelles. In this case, the diagnosis is very difficult, so much so that we have even seen experienced men deceived. In such cases, auscultation is of great assistance in diagnosticating the position.

There is one more obstacle to making a diagnosis. This is the overlapping of the bones, leading to the disappearance of the sutures, and distortion of the fontanelles, particularly of the posterior one. In place of the depression formed by the sagittal suture, we now feel only an osseous ridge formed by the prominent border of one of the parietal bones. The angle of the occipital bone is also covered by the posterior border of the parietals, and the posterior fontanelle is replaced by a little depression not possessing the characters of the posterior fontanelle. We recommend, in these cases, to follow this ridge to its end. It terminates, necessarily, at the anterior fontanelle, which, being larger, will always more clearly present its distinctive characters, *i.e.*, its rhombic shape with its four angles. In these cases, however, the four sutures ending at these angles will be replaced by prominences, formed by the projection of the parietal bones above the posterior border of the frontal, and by the ridge caused by the approximation of the lateral halves of the frontal.

2. *Position O.L.P.*

The details furnished above simplify the diagnosis of this position very much.

Palpation.—The hand again penetrates more deeply on the left than on the right. The resisting surface is, it is true, still on the left, but we find it far to the left and behind, and when we palpate in front it seems much narrower, and is, in reality, only the right lateral surface of the fœtus, the back being directed backward. To perceive this, which is not always easy, we must place the woman on her right side, the abdomen resting on the bed. We can thus, in many cases, feel the back.

Auscultation.—The maximum intensity of the heart-sounds is below the line dividing the uterus into two equal parts, and, according to Depaul, on a line uniting the left sacro-iliac synchondrosis to the umbilicus. According to Tarnier and Chantreuil it is on a line passing from the navel to the left antero-superior spine of the ilium.

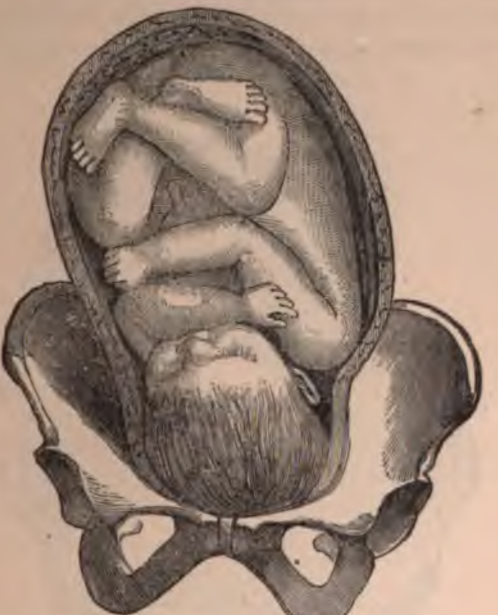


FIG. 196.—PRESENTATION OF VERTEX. (O.L.P.)

Vaginal Touch.—The posterior fontanelle is behind and on the left, on a level with the left sacro-iliac synchondrosis; the anterior fontanelle is on a level with the right ilio-pectineal eminence. That is, the sagittal suture occupies the right oblique diameter, the posterior or the anterior fontanelle being more or less accessible, according to the more or less marked flexion, and the more or less thorough engagement of the head.

3. *Position O.L.T.*

It is only by the touch that one clearly recognizes this position. The sagittal suture occupies the transverse diameter, and we feel the posterior fontanelle at the left extremity of the transverse diameter, *i.e.*, at the middle of the left innominate line. The anterior fontanelle is at the other end of the transverse diameter, *i.e.*, at the level of the middle of the right innominate line.

4. *Position O.R.P.*

This position is the most frequent after the position O.L.A.

a. *Before Labor.*—By palpation we ascertain the presentation to be a vertex. But here the hand which depresses the abdominal wall on the left side meets with the most opposition, and enters less profoundly because of the prominence of the forehead at the level of the left ilio-pectineal eminence. We, therefore, seek the back on the right side, but, as it is turned backward, the resisting plane is narrower, and, in order to plainly feel the back, we must place the woman completely upon the left side, so as to be able to palpate the right postero-lateral region of the uterus.

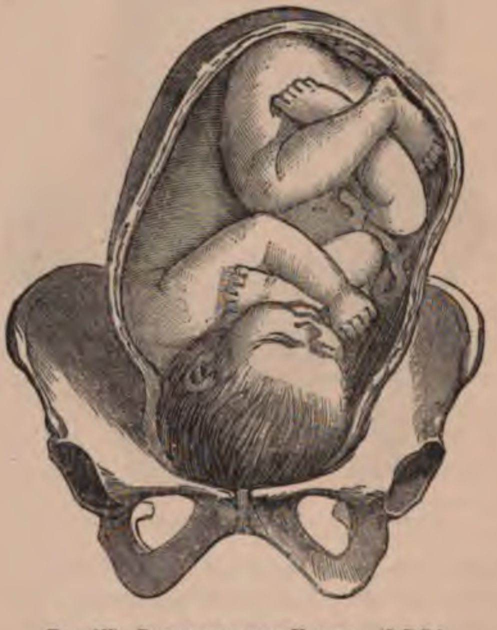


FIG. 197.—PRESENTATION OF VERTEX. (O.R.P.)

Auscultation.—The point of maximum intensity of the heart-sounds is, according to Depaul, near the quadratus lumborum, on a line passing straight from the right sacro-iliac synchondrosis to the umbilicus. According to Tarnier and Chantreuil, the maximum is on a line passing from the navel either to the right ilio-pectineal eminence or to the right antero-superior iliac spine. They say that, the left side of the fœtus being in relation with the antero-lateral wall of the uterus and of the abdomen, it is through this lateral surface and not through the back that the heart-sounds reach the ear. Vaginal touch rarely allows a recognition of the position before labor.

b. *During Labor.*—The same signs on palpation and auscultation.

Vaginal Touch.—The posterior fontanelle is behind, on the right, on a level with the right sacro-iliac synchondrosis at the posterior extremity of the left oblique diameter. The anterior fontanelle is in front and on the left, on a level with the left ilio-pectineal eminence, *i.e.*, at the anterior end of the left oblique diameter. The sagittal suture occupies the left oblique diameter.

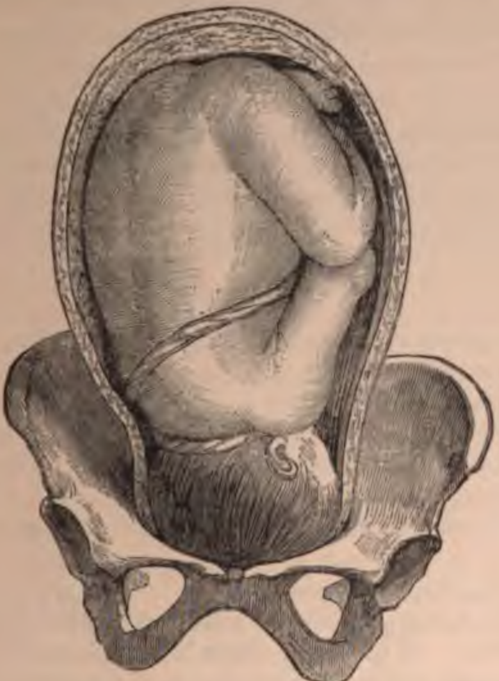


FIG. 198.—PRESENTATION OF VERTEX. (O.R.A.)

5. *Position O.R.A.*

On palpation, the hand enters farther on the right than on the left, the forehead being on the left. The resisting plane formed by the back occupies the whole right side of the abdominal wall.

Auscultation.—The maximum intensity of the heart-sounds is, according to Depaul, on a line passing from the right ilio-pectineal eminence to the navel. According to Tarnier and Chantreuil, who base their view upon Ribemont's researches, this maximum is on the median line, or sometimes even a little to the left of that line.

Vaginal Touch.—During labor, the posterior fontanelle is in front and at the left, at the anterior extremity of the right oblique diameter, *i.e.*, on a level with the right ilio-pectineal eminence. The anterior fontanelle is on a level with the left sacro-iliac synchondrosis, *i.e.*, at the posterior extremity of the right oblique diameter. The sagittal suture corresponds to the right oblique diameter.

6. *Position O.R.T.*

Vaginal touch, alone, establishes the diagnosis. The posterior fontanelle occupies the right extremity of the transverse diameter, the anterior fontanelle the left end of the same diameter. The sagittal suture is parallel to the transverse diameter.

MECHANISM.

The characteristic features which we have just assigned to the different vertex presentations are those presented before labor and at the beginning of labor. They will permit us to closely follow the different periods of labor, *i.e.*, to follow the movements which the fœtus passively executes, under the influence of the pains, during its expulsion from the genital canal.

1. *Position O.L.A.*

We take, as a type, the position O.L.A., the most frequent vertex position. There are six periods.

1. Period of moulding (flexion.)
2. Period of engagement.
3. Period of internal rotation of the head.
4. Period of expulsion of the head.
5. Period of external rotation of head and internal rotation of the trunk.
6. Period of expulsion of the trunk.

First Period, that of Moulding.—This period is called that of flexion, by certain authors. (Fig. 194.) When labor is about to begin, the head is in the following position: The occiput is at the left ilio-pectineal eminence, the forehead at the right sacro-iliac symphysis, the sagittal suture in the left oblique diameter, the posterior fontanelle in front and on the left, the anterior fontanelle behind and on the right. The posterior fœtal surface is directed forward and to the left, the anterior surface backward and to the right, the right lateral surface and the right shoulder looking forwards and to the right, the left lateral plane and the left shoulder backward and to the left. The head is semi-flexed. The diameter O.F. lies in the left oblique diameter. The bi-parietal diameter, B.P., in the right oblique diameter, and the circumference which passes through the ends of the diameter O.F. is that which corresponds to the margin of the superior strait. According, then, to our view, the head presents perpendicularly to the superior strait, and what has been called the obliquity of Naegelé and of P. Dubois does not exist.

These two authors stated that the head presented, at the superior strait, slightly inclined toward its anterior parietal bone, the parietal eminence on that side being lower, and so more accessible than that of the other parietal. Contested, even, by Velpeau and Cazeaux, the obliquity of Naegelé has been recently denied, *in toto*, by Matthews Duncan and by Kuneke. Kuneke gives to the perpendicular descent of the head into the pelvis the name of synclitic movement, and supposes this to remain until the exit of the head, while, according to Matthews Duncan and Playfair, Naegelé's obliquity is produced when the head reaches the floor of the pelvis. In short, the synclitic movement gives place, at that time, to an asynclitic movement. In other words, Kuneke and Duncan say that the presenting point, "the point of the head which is traversed by the axis of the genital canal," is always, or should always be, on the median line and on the sagittal suture, not, as Dubois and Naegelé say, on the anterior parietal bone. But we agree, with Matthews Duncan, that if the head descends thus synclitically or perpendicularly until it meets the resistance offered by the lower half of the sacrum and the pelvic floor, *i.e.*, with the axis of the superior strait traversing the sagittal suture, it is no longer so when the head has passed beyond the middle of the pelvis. Then, so soon as it has passed the transverse plane cutting the middle of the third sacral vertebra, the head is inclined, and the pelvic axis traverses a point on the anterior parietal bone, instead of passing through the sagittal suture. In short, the obliquity of Naegelé is produced in the lower half of the pelvis. If it be true, as Cazeaux observes, that the palpating finger reaches the anterior parietal eminence, and not the sagittal suture, this is because of the forward and downward inclination of the pelvis, and because the vaginal axis crosses the axis of the superior strait at nearly a right angle. The finger, thus, necessarily reaches that part of the head which is in front, *i.e.*, the anterior parietal bone, the right one in left positions, and the reverse.

The head, placed perpendicularly to the plane of the superior strait, is semi-flexed. It represents a lever, the arms of which are not equal. The shorter arm corresponds to the distance between the angle of the occipital bone and the foramen magnum. the longer arm to that part of the head between the foramen and the chin. According to the depth of its engagement, the head is acted upon by two forces, one of which is the uterine contraction, and the other the resistance offered by the borders of the pelvis, the pelvic walls or the perineal floor, as the case may be. The superior force, acting downward, is transmitted by the spine to the foramen magnum. Since this foramen divides the base of the cranium into two unequal arms, the force will act more strongly on the short arm, *i.e.*, on the occiput, than on the other arm, *i.e.*, the chin. The chin will be thus elevated and the occiput depressed. The chin, in being raised, is approximated to the chest and flexion is complete. On the other hand, the resistance of the superior strait, of the pelvic walls or of the perineum, as the case may be, acting in the opposite direction, *i.e.*, from below upward, will contribute to the same result, *viz.*, the elevation of the forehead and the completion of flexion. This movement is complete when the chin is in contact with the upper piece of the sternum. The head is flexed, whether the chin is elevated or the occiput depressed. The higher in the pelvis this resistance is felt, the sooner flexion will occur. Placing the finger on the anterior fontanelle, one can follow the progressive descent of the occiput and the progress of flexion, which is complete in proportion as the posterior fontanelle is near the centre of the pelvis. Now, in the beginning, flexion having hardly commenced, the anterior fontanelle is nearer to the pelvic centre, and it will be felt to withdraw from the centre as the posterior fontanelle tends to approach this point. The result of flexion is to substitute a smaller circumference and diameter for the frontal circumference and the occipito-frontal diameter, which were in relation with the superior strait.* We allude to the sub-occipito-bregmatic cicumference and the sub-occipito-bregmatic diameter. A diameter of 3.70 inches thus replaces one of 4.48 inches, and, as the fœtus has become more and more flexed upon itself under the influence of the pains, so as to occupy the least possible space, a diminution in the size of the fœtus has really taken place. This reduction in size is accomplished by the completion of flexion. In face presentations, on the contrary, it is effected by extension. Let us add Pajot's remark that the fœtus "before flexion, could be considered as a broken and waving branch, the mobility of which was particularly resident in the articulation of the head and of the trunk. Now, a solid body, thus situated, is in an unfavorable position to transmit force applied to its extremities. But the cephalic extremity, so soon as it is fixed upon the thorax, is very fortunately so placed as to participate in the impulsion imparted to the whole fœtal mass, and, besides, the head, being compressed by the pelvic canal, can, in virtue of its compressibility, and under the influence of the total uterine effort, adapt itself to the shape and size of the pelvis and thus add a further reduction in volume to that already obtained by its changed position." The term period of moulding is thus quite justifiable.

Second Period.—Period of Engagement of Descent.—Thus flexed, the head passes through the superior strait and the whole pelvis to the pelvic floor, where it is arrested. Since, however, the posterior pelvic wall is much longer than the anterior, it follows that the posterior part of the head has a longer journey to make than the anterior part, and that the head thus describes a sort of arc of a circle around the anterior end of the bi-parietal diameter, which is almost immobile, in front and on the right, while the posterior extremity rapidly descends along the posterior pelvic plane. During the descent the head has passed through the cervix, and it is during the second part of the descent that, according to Matthews Duncan, the head descends by an asynclitic movement. When the descent is completed the two parietal eminences are at the same level, and rest upon the perineum. Although one may separate these two periods, for purposes of study, they are, in reality, rarely distinct. Most frequently flexion and descent occur simultaneously. It is even the rule that flexion does not become complete until the head encounters the resistance of the pelvic floor. This rule obtains especially in primiparæ, in whom the engagement is quite pronounced, even at the beginning of labor, and in whom it is not rare to find the head, still retained by the incompletely dilated cervix, in the lower part of the pelvis. Nevertheless, everything depends on the pelvic resistance, and, as we shall see when we come to consider the mechanism of labor in contracted pelvis, where pelvic resistance is most marked, the engagement can only occur after exaggerated flexion of the head has taken place. In such cases flexion necessarily occurs above the superior strait, thus furnishing the proof of the utility of the first period of fœtal progression, *i.e.*, of complete flexion.

Third Period.—Internal Rotation.—Upon its arrival at the pelvic floor, the head executes a movement of rotation which brings the occiput to the front. This movement occurs, no matter what the primitive position may be, whether left or right, anterior, transverse or posterior. In the position O. L. A., which we are now considering, the movement takes place from left to right, *i.e.*, the occiput passes beneath the symphysis pubis. This rotation will take place more easily if the occiput is originally far forward in the pelvis.

The causes of this rotation have been the subject of much discussion and have been explained in a great many different ways. The theory of the pelvic inclined planes, adopted by Baudelocque and his pupils, down to Velpeau and Dubois, was the first which was generally recognized. The pelvis was held to present two inclined planes, one anterior and one posterior. When the occiput was originally placed in the anterior plane it turned forward, and when it occupied the posterior plane it turned backward. But, Naegelé having shown that the occiput comes forward even when it was, originally, behind, it was necessary to find other explanations. Paul Dubois, after experimenting on the cadaver, arrived at the conclusion that the cause of the rotation lies, 1st, in the volume, form and mobility of the parts to be expelled; and 2d, in the capacity, form and resistance of the genital canal. He attaches much importance to the resistance of the perineum. Hubert de Louvain and Cazeaux sought to explain the phenomenon on mathematical and mechanical principles, but their explanations, which might perhaps account for the rotation in anterior positions, are insufficient for posterior positions. De Soyre seems to return to Baudelocque's inclined planes, and gives two explanations according as the head is originally in front or behind. "If it is in front, he assumes flexion to be as complete as possible, and, as a result, the occiput to be depressed and to rotate only when it reaches the perineum. The perineum represents a wall inclined from behind forward, from below upward and from without inward. Now the occiput, upon which the uterine forces are expended, is placed on the side and is pushed by the uterine contractions against the perineal floor, which will direct it forward and inward. In posterior positions, the flexed head descends to the pelvic floor, the resistance of which first augments the flexion. But, the direction of the pelvic floor being from below upward, and from behind forward, the head follows this inclined plane until, the occiput remaining constantly behind, the anterior part of the cranium comes to be applied to the osseous rim of the pelvis on the opposite side. The occiput is directed upward and forward, *i.e.*, it turns toward the symphysis and the more in proportion as the perineum is more resistant." Truly, the resistance of the perineum aids rotation, but if perineal resistance were the sole cause, rotation ought never to be absent in primiparæ, the perinea of whom are so resisting. Now, it is especially with them that rotation often fails, and intervention becomes necessary. Tyler Smith, Leishman and Playfair, refer rotation to the inward projection of the sciatic spines, which contract the transverse diameter of the inferior strait. " As the pains depress the occiput, its backward rotation is prevented by the left sciatic spinous process, while its forward rotation is favored by the smooth, angular surface of the ascending ramus of the ischium. In the same way, the spinous process of the opposite side prevents the forward rotation of the forehead, which is directed backward toward the concavity of the sac-

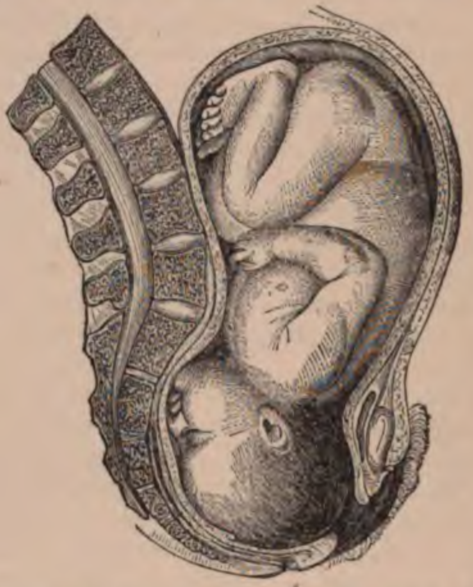


FIG. 199.—FIRST POSITION OF VERTEX.—THE HEAD IN THE EXCAVATION.—FORWARD ROTATION.

rum by the smooth surface of the sacro-sciatic ligaments. These arrangements give, thus, the shape of the thread of a screw to the interior of the pelvis, and, as the pains push forward the head, they impart to it the rotation which is so important in adapting it to the largest dimensions of the inferior strait." (Playfair.) In Germany, this movement is attributed to the increasing resistance which the head experiences on the part of the posterior pelvic wall and of the perineum. Playfair's theory, which is good for anterior positions, does not explain rotation in the posterior positions. Tarnier holds that: 1st, rotation does not occur until flexion is complete; and 2d, that when the head is flexed and engaged it is directed downward and forward, as a result of the inclination of the pelvic floor. Rotation, like flexion, is explained by the unequal length of the arm of the lever. His explanation somewhat resembles that of de Soyre. Depaul, recognizing the inadequacy of these explanations, limits himself to the indisputable statement that the head turns, and that this rotation extends to the whole body of the child. Pajot says that the causes are multiple, but it is, above all, the shape of the head which decides the character of the movement. "The occiput, being only a mathematical point, will oscillate, slip and escape, under the influence of the pains, to be replaced by a more extended surface. The head in the position O.R.P., for example, must rest, because of the direction of the superior strait, upon the right posterior lateral region, which extends from the occiput toward the parietal eminence of the same side. The occiput will, therefore, be carried forward, less on account of the direction of the forces which impel it than because of the necessity for accommodation of the cephalic surfaces to the pelvic surfaces, and so, step by step, until the occiput, having passed beneath the ischio-pubic ramus, there encounters an inclined plane which forces it to advance beneath the pubes and to thus complete its anterior rotation." He finds, here, the application of the following mechanical law: When a solid body is contained in another, which is the seat of alternating movement and repose, if the surfaces are smooth and rounded, the contained body will constantly tend to accommodate its form and dimensions to the capacity of the containing body. This explains why rotation fails when the fœtus is too large or too small, and when the pains are too feeble. Usually, rotation occurs slowly and progressively, but sometimes, particularly in multiparæ, this movement occurs very rapidly, even under the influence of a single pain. It is not rare, in the case of women who have borne several children, to see the head, arrested by the last resistance of the cervix, pass through the cervix under the influence of a more energetic contraction, descend to the vulva and be expelled, either by this single pain or by the succeeding one.

Pajot's explanation seems to us the most rational of all. Without advancing any explanation of our own, we desire to record the results obtained by rotation in the position O. L. A., now being considered. The occiput having engaged beneath the symphysis pubis, and the child's body having participated in this rotation, the shoulders and the upper part of the body have descended into the pelvis, the back of the fœtus looks forward, the anterior surface backward, and the bi-acromial diameter is in relation with the transverse diameter of the pelvis. The diameter sub-occipito-frontal lies in the coccygeo-pubic diameter, the bi-parietal diameter in the bi-ischiatic diameter, the sub-occipito-frontal circumference corresponding with the inferior strait. It is, thus, only held back by the coccyx and laterally and in front by the perineum. Now, the coccyx is mobile, and its recession to the rear enlarges the antero-posterior diameter of the inferior strait. It is, therefore, in the most favorable condition for expulsion.

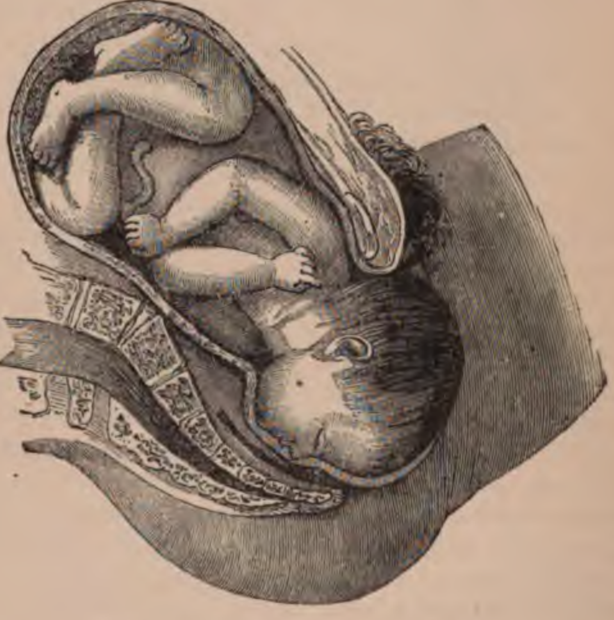


FIG. 200.—DISENGAGEMENT OF THE HEAD.

Fourth Period.—Expulsion.—This stage is accomplished by a movement of extension. Rotation having taken place, the occiput, under the influence of the pains, is engaged beneath the symphysis and fixed there by the sub-occipital region. It is thus withdrawn from the influence of uterine action, which, however, continuing, will produce two effects: 1st, the descent of the body of the fœtus; and 2d, the bending of the fœtus on its posterior plane, *i.e.*, upon the maternal abdominal wall. This bending will separate the chin from the chest a little, and will thus begin the movement of extension. Again, the pains will tend to engage the shoulders as deeply as possible, but the neck, being fixed below the symphysis, the uterine forces, having produced their full effect on the shoulders and body of the fœtus, and not being able to act on the occiput, will be transmitted through the foramen magnum to the anterior arm of the cephalic lever, the chin. This is, indeed, the only remaining mobile part. The uterine action, being expended on the chin, will depress it, and will thus force the head to be extended, and finally expelled. The occiput being disengaged and the neck fixed beneath the symphysis, the sub-occipital region becomes the pivot around which the head describes its movement of extension, and the chin being pressed more and more backward, the head will be expelled by the successive liberation of the sub-occipito-bregmatic, of the sub-occipito-frontal and of the sub-occipito-mental diameters. All these diameters are shorter than the coccygeo-pubic, so that only the perineum opposes itself to the exit of the head, which will be rapid or slow, according to the amount of perineal resistance.

Tarnier rejects the above explanation of Cazeaux and Pajot. Here is his view of the case: "The trunk becomes engaged in the pelvis, while the head distends the perineum, and the chin remains applied to the chest, not only until the occiput takes its place below the pubic arch, but even until the bregma appears at the posterior commissure. Then the perineum acts like an elastic band, which, on the one hand, pushes the head upward, beneath the pubic bone, and on the other, quickly glides over the face, which it leaves uncovered. The liberation of the occiput and of the vertex only commences when the head is pushed backward by the trunk, but, at this moment, the perineum, hitherto passively distended, resumes its activity and, retracting and gliding over the face, impresses upon the whole head a movement of extension, which makes the pubic arch its central point. Moreover, it is in this second period of expulsion of the vertex that the movement of extension is truly evident."

We cannot entirely agree with this explanation, which, if applicable to the end of extension, does not apply to its beginning. After its rotation the occiput is not suddenly but progressively liberated, and it is not brought into close contact with the perineum until it is completely freed. Until that time it remains at a certain distance from the perineum, and if we introduce the finger posteriorly, we feel that the head is retained behind by its frontal eminences, on the sides by the bi-parietal eminences, and that there is a certain space between the perineum and the bregmatic region. In order that the bregma may be brought into close contact with the perineum, the occiput must be liberated from under the symphysis, and the bregma must descend, which it cannot do at this moment, unless the head becomes extended. If we suppose flexion to persist, as Tarnier says, the perineum will not only have no tendency to produce extension, but will tend to prevent it. But if we suppose the first degree of extension to have been produced by the mechanism suggested by Cazeaux and Pajot, at the moment when the bregma appears at the vulva, then the perineum can act as Tarnier supposes it to do, and can thus complete extension, and lead to the final expulsion of the head. However this may be, the head is expelled by its sub-occipital diameters, in performing a movement of extension. When the head is once freed and the perineum retracted, the head falls over the anus, by its own weight, and remains immovable a short time, when the fifth period begins.

Fifth Period.—External Rotation of the Head.—This movement consists in external rotation of the head, which turns the occiput towards the thigh of the mother, which corresponds with the side of the pelvis which it originally occupied, *i.e.* the left thigh in the position O. L. A., while the face is turned toward the opposite thigh. This movement has long been known as the movement of restitution (Fig. 201). It was supposed that, in the movement of internal rotation, only the head rotated, the neck being twisted, and hence external rotation, corresponding to the untwisting of the neck, gave the name of movement of restitution to the stage in question. There is, in reality, a slight twisting and untwisting of the neck, but that is not the true cause of the external rotation of the

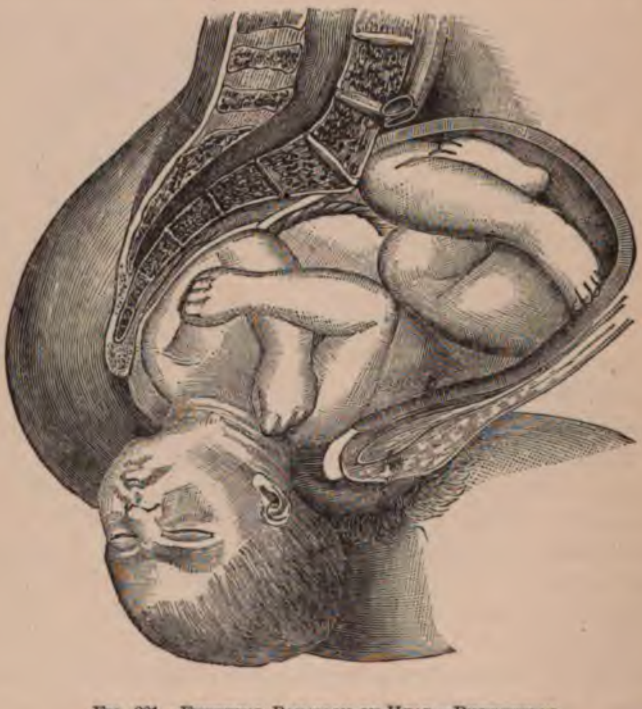


FIG. 201.—EXTERNAL ROTATION OF HEAD.—RESTITUTION.

head. Gerdy first showed that this movement, which always occurs at the time of a pain, is only the external expression of a movement of the shoulders, within the pelvis, by which the bi-acromial diameter passes from the transverse to the antero-posterior diameter of the outlet, the head merely following this internal rotation of the shoulders. A fact which proves that the neck has been slightly twisted is that often, just when the head has been expelled, it executes a slight rotatory movement which causes it to assume a slightly oblique position relatively to the vulva. This movement is really due to an untwisting of the neck, and is the genuine movement of restitution of the books.

Sixth Period.—Expulsion of the Trunk.—When external rotation has occurred, the trunk is expelled. The anterior shoulder, the right one in the position O. L. A., takes its position below the symphysis and appears at the vulva. It becomes fixed beneath the symphysis, as the occiput did, and thus partly liberates itself, but, in reality, it is the posterior, or left shoulder which, pushed by the uterine contraction, sweeps over the whole posterior pelvic wall and is completely expelled before the other. The rest of the body escapes with a spiral movement, and, generally, very rapidly. But, in some cases, we see the expulsion of the nates effected in the same way as that of the shoulders, the anterior appearing first under the symphysis, the posterior side being completely expelled before the former. This description most exactly suits those cases in which the fœtuses are very large.

2. *Position O. L. P.*

The details given in our description of the position O. L. A. enable us to deal more concisely with the other positions. We have already seen by what means the position O. L. P. is recognized, and have now only to describe the mechanism which embraces the same six periods or stages.

First Period.—Flexion.—The head is in the right oblique diameter, the occiput behind and to the left, the forehead in front and to the right, the posterior fontanelle behind and to the left, on a level with the left sacro-iliac synchrondrosis, the anterior fontanelle at the right ilio-pectineal eminence. The posterior surface of the fœtus is behind and on the left, the anterior surface looks forward and to the right, the diameter O. F. occupies the right oblique diameter, the circumference O. F. is in relation with the margin of the pelvic inlet, at first, and the diameter B. P. lies in the left oblique diameter.

First Period.—The head is flexed, as in the left anterior position, and the fœtus is diminished in size.

Second Period.—Descent or Engagement.—The engagement occurs more slowly than in the anterior position it is always less deep, and the occiput, descending less, is still in relation with the sacro-iliac synchondrosis when rotation commences.

Third Period.—Internal Rotation.—This is the longest stage. The occiput starts from the posterior part of the pelvis and the path which it has to pursue is much longer, and the conditions for accommodation less favorable. The occiput again turns from left to right, and finishes by passing beneath the symphysis. The body accompanies this movement, and, when rotation has once occurred, the fourth, fifth and sixth periods follow, as in the position O. L. A.

3. *Position O. R. P.*

In this position, the head is placed in the left oblique diameter, the posterior fontanelle at the level of the right sacro-iliac symphysis, the anterior fontanelle on a level with the left ilio-pectineal eminence, the diameter O. F. in the left oblique diameter, and the diameter B. P. in the right oblique diameter. The back looks backward and to the right, the anterior fœtal plane forward and to the left, and the circumference O. F. is in relation with the superior strait.

First Period.—Flexion.

Second Period. — Engagement or Descent takes place slowly, and is less complete than in anterior positions. The occiput descends along the right sacro-iliac synchondrosis, and is still in contact with this articulation when rotation begins.

Third Period.—Internal Rotation.—This is very long, on account of the distance through which the occiput must pass, turning as it does from right to left in order to get beneath the symphysis. The trunk follows, and rotation becomes complete.

Fourth Period.—Expulsion.—As in the position O. L. A.

Fifth Period.—External Rotation.—The occiput turns toward the woman's right thigh, the face toward the left thigh. This movement corresponds to the internal movement of the shoulders. The slight twisting of the neck is rather more pronounced than in the anterior positions.

Sixth Period.—Expulsion of Trunk.—As in position O. L. A.

4. *Position O. R. A.*

This is the rarest original position of all. It is generally secondarily produced, during rotation in the position O. R. P. We subjoin the relations of the fœtus: The posterior fontanelle is forward and on the right, on a level with the right ilio-pectineal eminence, the anterior fontanelle behind and on the left, on a level with the left sacro-iliac symphysis, the diameter O. F. in the right oblique diameter, and the circumference O. F. in relation with the superior strait. The back of the fœtus looks forward and to the right, and its anterior surface backward and to the left. The first to the fourth periods, inclusive, are similar in mechanism to the description already given. The occiput turns toward the woman's right thigh, and the face toward the left thigh.

Such is the normal mechanism of labor. But irregularities or anomalies may arise in either of the periods, which, although they do not deprive delivery of its physiological character, and do not modify its general physiognomy, yet deserve to attract our whole attention. These irregularities are often the cause of the obstetrician's intervention (*vide* Dystocia). However, they more frequently still permit labor to be regularly and spontaneously completed.

ANOMALIES IN THE MECHANISM OF LABOR.

First Period.—Flexion.—This movement rarely fails, but, when it is absent, it may transform a physiological into a pathological labor. Ordinarily, the anomalies consist in an exaggeration or in a diminution of this flexion. These are the anomalies which constitute, according to the German view, occipital or frontal positions. Generally, however, labor is simply retarded, flexion being completed in the pelvis or on the pelvic floor, and the position being regulated, after a time, by the uterine contractions. The situation of the fontanelles, as regards the centre of the pelvis, will suffice for the recognition of these anomalies.

Second Period.—Engagement or Descent.—The anomalies are here rather physiological varieties. Two conditions govern these, *viz:* the dimensions of the canal and of the fœtus, on the one hand, and the intensity of the pains, on the other. The varieties consist in varying degrees of engagement, the vertex being at the superior strait, a little below it or low in the pelvis.

Third Period.—Internal Rotation.—Anomalies are most likely to occur in this stage. Rotation may be absent, incomplete or exaggerated. It may, particularly in posterior positions, occur before the head reaches the pelvic floor, the first three stages occurring simultaneously. When rotation is exaggerated, the occiput, after its arrival beneath the symphysis, instead of becoming fixed in that position, passes to the other side, transforming, thus, a left into a right position, or the reverse. After a time, however, the occiput returns beneath the symphysis, and labor is completed as if the original rotation had been regular. When rotation does not take place, if the head is small, labor may yet be spontaneously completed, even in primiparæ, in spite of the feeble pains which usually occur in such cases. In multiparæ, the rotation is of less importance, as the soft parts offer less resistance. If rotation is absent, the head escapes in an oblique position, the occiput resting upon one of the ischio-pelvic rami. Labor is much protracted, in these cases. The trunk sometimes fails to participate in the internal rotation of the head. In this case a genuine torsion of the neck occurs, and, consequently, incomplete rotation of the head. The head is expelled, as in the former case, obliquely, and it is in this case that restitution really occurs, the neck being forcibly untwisted, when the head is expelled. But the most serious anomaly is the perversion of rotation. In certain cases, rotation, instead of occurring in a forward, takes place in a backward direction, the occiput turning into the hollow of the sacrum, so that the position becomes occipito-sacral (Fig. 202). This anomaly, which ordinarily makes intervention a necessity, may yet allow of a normal termination of labor. The labor is prolonged for a reason first given by P. Dubois. The occiput must, as all accoucheurs admit, pass along the whole posterior surface of the pelvis, which is much longer than the anterior wall. But, moreover, the fœtus represents, in this case, a straight and rigid branch or stem, 5.06 to 5.46 inches long, and, consequently, longer than the pelvic diameters. This rigidity will persist until the occiput shall have escaped from the pelvis, which it will only do after passing over the whole posterior pelvic and perineal surface.

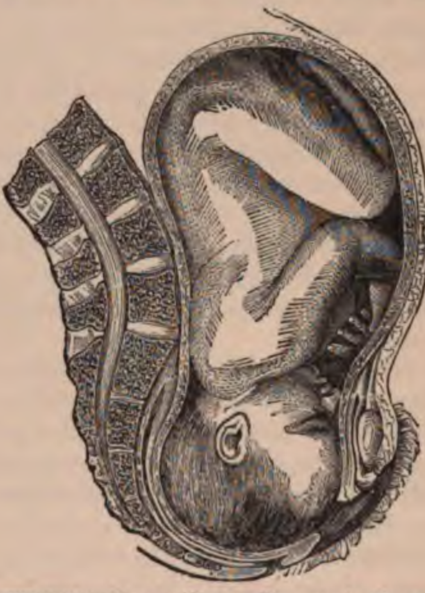


FIG. 202.—PRESENTATION OF VERTEX (OCCIPUT POSTERIOR). BACKWARD ROTATION.

When posterior rotation occurs, labor may be completed in different ways. Generally the head becomes forcibly flexed, the occiput looking backward and the forehead resting against the pubes until the occiput reaches the posterior commissure of the perineum. It then escapes first, and the neck having become fixed against the commissure, one sees the successive expulsion of the bregma, the face and the chin. According to Cazeaux, the head remains oblique. Exaggerated flexion occurs, as before assumed, but the forehead reaches the inferior strait first. The anterior frontal eminence becomes engaged beneath the pubic arch, and fixed there, and the occiput, traversing the postero-lateral wall of the pelvis, is first liberated by the perineal commissure. The descent of the occiput causes the frontal eminence to ascend behind the pubes, and it is not until the escape of the occiput over the perineum, that extension is produced and the head expelled. The bregma escapes first, then the forehead, the face and the chin. Tarnier and Chantreuil state that: "while the occiput traverses the perineum, forcibly distending it, the region of the anterior fontanelle, and the upper part of the forehead, are the parts which first descend to the vulva. The occiput has hardly reached the perineum at the moment when the whole forehead is being expelled anteriorly. When the occiput has once escaped, the head makes a movement of extension, having for its centre the perineal commissure, which supports the sub-occipital region, and expulsion occurs by the successive engagement of the sub-occipital diameters. The chin escapes last beneath the pubes." Guillemot has seen the position O. R. P. spontaneously converted into a face presentation at the inferior strait, *i.e.*, the movement of extension exaggerated, and the chin first expelled beneath the symphysis. This mutation seems very hard to reconcile with the normal pelvic diameters, for it is necessary that the occipito-mental diameter, which is 5.26 inches, should swing in a pelvis with a diameter of only 4.68 inches. Charrier has seen one example in a normal pelvis, but there was central perineal laceration, and the engagement of the occiput in the laceration allowed of the swinging movement. Cazeaux further says, that he has seen one such case. The failure of rotation is one of the most frequent causes of intervention (*vide* article Dystocia).

Fourth Period.—Expulsion.—The anomalies are dependent on those of the third stage. Expulsion occurs, according as rotation is incomplete or absent, obliquely, or over the commissure of the perineum.

Fifth Period.—External Rotation.—It is dependent upon the movement of the shoulders. If rotation of the trunk does not take place, external rotation fails. If it is extreme, external rotation is exaggerated. If, on the contrary, rotation of the shoulders occurs in a direction the reverse of what it should have been, the head follows this movement on the exterior, and, in the left positions, for example, rotation takes place as in the right positions and the reverse. But, most frequently, it must be admitted, this rotation, which seems irregular, is perfectly normal, and is considered irregular only because one has wrongly diagnosticated the position.

Sixth Period.—Finally, the expulsion of the shoulders may take place obliquely or even transversely. We will see, in the article on "Dystocia," that their exaggerated size, and the absence of their rotation may, in certain cases, create difficulties not always easy to surmount, and which demand rapid and active interference.

SHAPE OF THE HEAD IN VERTEX PRESENTATIONS.

The moulding experienced by the head in passing through the pelvis is of two kinds, one affecting the soft parts, and the other the cranium. The former constitute the caput succedaneum, and the latter the true cranial distortions.

Caput Succedaneum.

This is a tumefaction formed upon the presenting fœtal part, and consisting in an œdematous, sero-sanguinolent infiltration of the sub-cutaneous cellular tissue of the part. The tumor always appears in that portion of the presenting part which corresponds to the pelvic cavity, *i.e.*, on the uncompressed part. It therefore varies with the presentations and the positions. On the vertex, it forms a tumor which is more or less prominent according as labor has been of greater or less duration, and the membranes have been long or but lately ruptured. The tumor is more or less violet in color, and upon it, in certain cases, are little ruptured or unbroken vesicles. It is, generally, limited to the skin. Sometimes it extends deeper, down to the periosteum, which it detaches, and to the bones, the vessels of which are distended with blood. In still rarer cases, the lesions have involved even the interior of the cranium, detaching the dura mater, and inducing congestion of the pia-mater and of the choroid plexuses. It was formerly supposed that the caput succedaneum was only formed during the period of dilatation and after rupture of the membranes. Schroeder and Budin's cases prove that it may sometimes be formed, even when the membranes are intact. Although generally small, from .78 to 1.5 inches in its longest diameter, it is sometimes large, particularly when the labor is long and the membranes are ruptured early. Its presence furnishes valuable data for a retrospective diagnosis of the position. Since it is always formed on the part corresponding to the pelvic cavity, its position varies with the position. Thus, in right positions, the caput will be upon the left lateral part of the head, in the left positions, upon the right side. In anterior positions it will be on the posterior part, and, in posterior positions, on the anterior part—in brief, on that part of the head occupying the front and centre of the pelvis. Thus, in

Position O. L. A., the caput is on the posterior superior angle of right parietal bone.
Position O. L. P., “ “ “ “ “ anterior “ “ “ “ “ “ “
“ O. R. A., “ “ “ “ “ posterior “ “ “ “ left “ “
“ O. R. P., “ “ “ “ “ anterior “ “ “ “ “ “ “

This is the general rule. Nevertheless, when the head, after escaping from the cervix and having rotated, remains a long time *in situ*, before being expelled, a second caput succedaneum may be formed. This one, however, is always placed on the median line, so that the first caput may be discovered, in front or behind, thus showing the nature of the original position of the head. When labor advances rapidly, the caput is either not formed or consists, merely, in a slight discoloration of the tissues. The caput has generally no influence upon the life of the child. It is usually limited to the thickness of the skin and disappears in twelve or twenty-four hours after labor, but, if it extends to the interior of the cranium, it may, of course, become dangerous to the child.

Distortions of the Bones.

Little known or neglected by the older authors, these distortions, which Kuneke calls the plastic phenomena of labor, have only recently been really studied by Stadtfeldt, Dohrn, Barnes, Hecker, Olshausen, Grossman, Schroeder, Spiegelberg, Perlis, Budin and Labat. To these authors belong the credit of calling attention to this very interesting point, and of showing that given distortions are distinctive of each presentation. Stadtfeldt showed, in 1863, that the shape of the cranium is greatly modified by the different positions of the head, and by its various movements during labor. He holds this to be particularly true of the brow and face presentations, and in those cases where the bi-parietal diameter of the head traverses the pelvis. This diameter is shortened, but the occipito-frontal diameter is elongated from one quarter to three quarters of an inch. Not only does an overlapping of the bones occur, but the borders of the bones are bent inward toward their centre. Ordinarily, the compression occurs in the diameter O. F. and in the vertical circumference, and the compensatory change occurs in the diameter B. P. When the pelvis is contracted, depressions and impressions result, and their traces remain either on the parietal or on the frontal bones. Dohrn shows that, the cranium being obliquely placed in the pelvis, the side of the cranium situated in front is more deeply engaged than the posterior one. The latter is, therefore, flattened by pressure against the posterior pelvic wall, while the anterior cranial surface is more spherical. Immediately after labor, the head of a child born with a vertex presentation is oblique. This is due partly to the caput succedaneum, and, partly, to the mutual lateral displacement of the two halves of the cranium. This is convincingly proved by the fact that one parietal eminence is placed farther for-

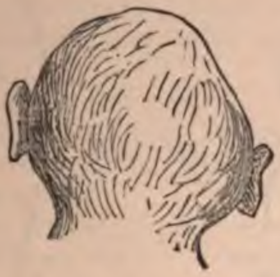


FIG. 203.—ASYMMETRICAL HEAD.—RIGHT PARIETAL BONE DEPRESSED BY THE PROMONTORY.

ward than its fellow. This displacement is due to the pressure exerted by the posterior pelvic walls. If we push a head, the occiput of which is deep in the pelvis, from above downward, toward the promontory, the side turned toward the promontory is depressed in front, near the sagittal suture. If, however, the front part of the head is deeply engaged, the part depressed by the promontory will be near the occiput, *i.e.*, behind. If we place the two fontanelles on the same level, the depression will correspond with the engagement of the anterior part of the head, and this depression will be more marked on the frontal side, in proportion as the obliquity of the head is more pronounced. Dohrn, on measuring with the cyrtometer, found this cranial depression in thirty-eight out of forty cases. The displacement in the first position of the vertex, O. L. A., averages .2 of an inch, in the second position, O. R. P., .26 of an inch. Olshausen states that the first and most common of the distortions is the depression of the occipital, beneath the parietal bone, and this can be ascertained so soon as labor begins. The same is true of the depression of the frontal, beneath the parietal bones. We may find, almost as frequently, a difference in the heights of the two halves of the cranium, (in more than two-thirds of all cases). Generally the depression of one half of the cranium is only perceptible on the parietal, but may, more rarely, be seen on the frontal bone. The posterior parietal and frontal bones are depressed twice as frequently as the anterior ones. The depression is rarely sufficient to produce overlapping of the lateral halves of the frontal. When

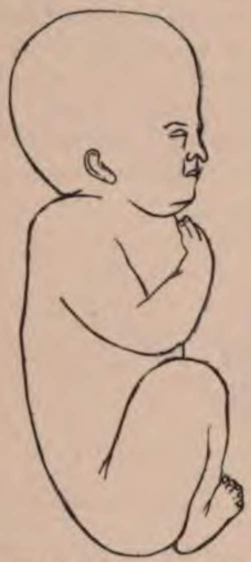


FIG. 204.—PRESENTATION OF THE BREECH.

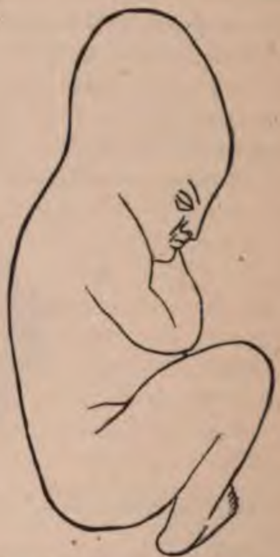


FIG. 205.—VERTEX PRESENTATION. DEFORMITY OF THE HEAD.

the overlapping does occur, all of one side of the cranium, particularly the parietal eminence, is carried backward on the side corresponding to the half of the cranium which is anterior. It is much more common to see disparity of form in the temporal fossæ. The fossa which is anterior is the deeper. Finally, it is not rare to see the posterior parietal alone depressed. Only rarely does the frontal of the same side participate in this flattening. The almost constant depression of the occipital and of the frontal beneath the parietal, shows that the pressure is constantly and early exerted on these bones. Olshausen refers it to the psoas and iliacus muscles, which lessens the transverse diameter of the inlet, although not sufficiently to prevent the descent of the head (Fig. 205).

The following are the results of his researches: Among twenty-seven cases, (twenty-five vertex and two breech presentations), in which the scalp showed marks of pressure exerted by the pelvis, he found: A single mark of depression, nineteen cases. A double mark, five cases. The double depression was on the same side in three cases. Triple depression occurred in two and quadruple depression in one case.

These thirty-nine depressions were situated as follows:

a. On the posterior aspect of the head, thirty-two times; especially on the parietal bone, twenty times; on the forehead, nine times; in the breech cases, on the posterior coronal suture, twice; on the posterior temporal, once.

b. Directly on the sagittal suture, once.

c. On the anterior surface of the head, five times; notably on the forehead or the frontal suture, twice; on Gasser's anterior fontanelle, once; on the parietal bone, three times.

Out of 160 vertex cases, the occiput was depressed beneath the parietals, 122 times; beneath one parietal only, 14 times. The occiput projected above the parietals, twice. In the other cases the overlapping was insignificant. The frontal was overlapped by both parietals 105 times. One half of the frontal was above, and the other below the corresponding parietal bone in six instances. The frontal was beneath the parietals once. In the other cases the overlapping was slight, unilateral or absent. Overlapping of the two sides of the head:—The posterior parietal was situated beneath, 79 times; the anterior one, 36 times. Both on the same level, 41 times. The other cases not noted. The frontals were generally at the same level. However, the posterior was lower than the anterior 21 times, and the anterior lower 21 times. Olshausen has reported 17 cases of depression of the posterior and three cases of depression of the anterior parietal.

Matthews Duncan does not admit, as does Dohrn, the action of the promontory, but that of the posterior wall of the lower half of the pelvis, for in normal labor, the pressure experienced by the head against the promontory is insignificant. It is only in the depths of the pelvis that the pressure becomes considerable. According to him, the two oblique distortions of Dohrn, one of which is lateral and the other vertical, are one and the same. The vertical distortion, *viz.*, the flattening of the posterior parietal, and the exaggeration of the vault formed by the anterior parietal, results from the resistance of the posterior pelvic wall. The lateral oblique distortion of Dohrn is only a part of the whole distortion. It depends on the obliquity of the head (Solayres de Renhac), and on the fact that the head rotates while this distortion is being developed. Playfair and Barnes have sought to show that the diameters O.M. and O.F. may be increased more than an inch by prolonged labor, while lateral compression may reduce the diameter B.P., even to the length of the inter-auricular diameter. Schroeder accepts Dohrn's view, and adds, that the liberation of the head with the occiput depressed, as happens in the usual cranial presentations, entails this consequence, that the cranium is compressed, during labor, as regards the sub-occipito-frontal diameter, while it may be elongated in the mento-bregmatic diameter. Besides, the cranium is compressed by the floor of the pelvis, in a transverse direction. While the forehead is descending, the occiput assumes a cylindrical or more pointed form. The diameters S.M.B. and B.P., are shortened and the diameters O.M. and O.F. elongated. The pressure of the pelvic floor against the posterior parietal bone, particularly in contracted pelves, produces a flattening of this posterior parietal, while the anterior parietal becomes more convex. Finally, the cranium of the newborn may present a lateral displacement of the two halves of the cranium, as regards each other. This is attributed, by Dohrn, to the pressure of the promontory, but is considered, by Stadfelt and Schroeder, as due to a congenital scoliosis of the cranial vertebra. Spiegelberg considers the distortions of the cranium as due to compression in the direction of the diameter S.O.F., exerted by the narrowest part of the genital passages, and to an elongation of the diameter O.M. Kuneke successively studies the condition of the fontanelles, the bones and the sutures, and considers the form of the cranium as the resultant of what he terms the vital and the mechanical forces. He seeks to show that the shape assumed by the cranium, is due to compensatory and to absolute phenomena. The latter consist in a diminution of all the cranial dimensions. His conclusions are as follows:

Posterior Vertex Presentation.—Normal presentation. The occiput is elongated and pointed. The head becomes cylindrical or pointed. The anterior parietal, not the posterior, is flattened (diagonal flattening of Dohrn). Finally one parietal slips in front of the other.

Anterior Vertex Presentation.—This presentation produces the least distortion. The head is more rounded. The transverse flattening and diagonal displacement of Dohrn occur.

Budin, measuring the diameters immediately after labor, and then forty-eight hours after labor, *i.e.*, when the head has resumed its original form, deduces from his measurements that:

1. The diameter O.M. is always increased, sometimes even to 2.48 inches.
2. The diameter sub-O.M., the maximum diameter, is always lessened .28 inches.
3. The diameter O.F. is almost always elongated.
4. The diameter S.O.B. is always most lengthened, ½ inch.
5. The diameter B.P. increases, but less than any other.
6. The diameter B.T. increases more than B.P.

These measurements are those made forty-eight hours after labor.

Budin concludes, from them, that: "In normal vertex labors, the diameters O.M. and O.F. diminish instead of increasing, as is generally supposed. The antero-posterior diameter, which increases, is a sub-occipito-mental or maximum diameter, hitherto always confounded with the diameter O.M. The diameter S.O.B. is sometimes considerably lessened."

The diameter B.T. also diminishes during expulsion. The diameter B.T., instead of being most diminished, is least so. This passive mechanism, affecting the head of the fœtus, is explained:

A. By the existence of the fontanelles. B. By the situation of the different sutures. C. By the arrangement and structure of the bones of the cranial vault, particularly: 1. By the existence of a fibro-cartilaginous hinge which, at birth, unites the basilar process to the occipital bone; 2. By the suppleness, and sometimes by the incomplete ossification of the internal or sagittal borders of the parietal bones.

Perlis, summarizing these experiments, concludes that: "1. During labor the cranium undergoes a compensatory change of shape and an absolute diminution in volume; 2. The modification in form is more marked than the absolute diminution; 3. The vertical diameter is much the most compressed. 4. The smaller transverse diameter is more shortened than the greater; 5. The right diameter is shortened not lengthened; 6. The larger diagonal diameter is reduced; 7. In mensurations, one must always measure the maximum diameter, which always increases; 8. The diameters elongated in labor return more quickly to their normal size than those which are shortened; 9. The diminished diameters elongate post-partum up to the fourth day; 10. The head is more distorted in primiparæ than in multiparæ; 11. The soft parts chiefly contribute to the distortion; 12. The longer the labor, after rupture of the membranes, the greater the distortion; 13. Births of boys are more difficult than those of girls."

Tarnier and Chantreuil admit the existence of absolute and of compensatory distortions, the latter predominating.

1. *Position O.A.*—The head is cylindrical. It is elongated from behind backward, but diagonally from the chin to the occiput, and flattened transversely and vertically. There is also present the asymmetry of the

two halves of the cranium, due to the depression and flattening of the posterior parietal, described by Dohrn, Barnes and Duncan, the parietal eminences being at different levels.

2. *Position O.P.*—If rotation occurs, the only difference between this and the anterior position, is the exaggeration of the depression at the level of the fronto-parietal suture, in anterior positions. If rotation does not take place, or if the occiput remains in the rear, the head is, as it were, drawn vertically from below upward. The crown is conical, constituting the "sugar-loaf head" of Kuneke. The forehead and the parietal bones are on the same plane, as well as the back, the neck and the occiput.

Labat, in 1881, commences by announcing this fact, that, "When one examines the head of a child at term, immediately after its birth, no matter what the position, if the labor was spontaneous and the pelvis normal, one is struck by two facts: 1. The parietal eminences are not on the same level, whether antero-posteriorly or vertically; 2. One parietal region appears flattened." Subsequently, examining the heads of two children extracted by Porro's operation, by Lucas Championnière and Tarnier, and comparing them with Budin's case, he concludes from their symmetrical shape, that the parietal distortion is certainly the result of labor, *i.e.*, of the pressure experienced by the head in the pelvis. But this symmetry is not properly absolute, and without adopting Stadfeldt's and Schroeder's views on cranial scoliosis, which results from spinal rotation of the embryo in the ovum, he believes, as do we, that many fœtal heads are originally asymmetrical, but not regularly so, either in seat or in degree. The following table (see below), borrowed from him, shows the result of his examination of twenty-one children. (The abbreviation N.P., designates the distance separating the root of the nose from the parietal eminences.)

From the table we may conclude that there exists, in both right and left-handed positions, a distortion characterized by general flattening of that parietal region, which, during labor, is in contact with the anterior pelvic wall, and a depression of the parietal eminence on the same side. In a single case, the distortion occurred on the side of the head which was in relation with the posterior pelvic wall. Labat agrees on this point, with Kuneke, and is opposed to Dohrn. Like Duncan, Labat holds that in normal labor, the head is not subjected to any pressure at the level of the promontory. "Very often the head has penetrated, in primiparæ, deeply into the pelvis, during the last three months, and during the last fifteen days in multiparæ." This asymmetry is only produced at the outlet and at the perineum, as Budin, Depaul, Matthews Duncan and we believe. We hold, with Labat, that this distortion is more marked in proportion, as the labor is long and difficult.

TABLE CONTAINING THE OBSERVATIONS OF LABAT, BASED UPON THE POSITION OF THE VERTEX, AND NOT UPON CHRONOLOGICAL ORDER.

Number of the Observation.	Primiparæ or Multiparæ.	Position.	Distance N. P. immediately after birth.	Distance N. P. when the head has become symmetrical.	Remarks.
I.	P.	O.R.P.[1]	Left, 8.9 Right, 8.2	Left, 8.1 Right, 8.1	
II.	P.	O.R.P.	Left, 9.2 Right, 8.9	Left, 9. Right, 8.6	Original asymmetry in level of frontal eminences and of the whole head.
XX.	P.	O.R.P.	Left, 9. Right, 8.3	Left, 8.5 Right, 8.5	Original frontal asymmetry.
IX.	M.	O.R.P.	Left, 10. Right, 9.5	Left, 9.6 Right, 9.4	
XI.	M.	O.R.P.	Left, 8. Right, 8.5	Left, 8. Right, 8.1	The distortion occurred as it does in right positions.
XII.	M.	O.R.P.			Complete symmetry of head.
XV.	M.	O.R.P.	Left, 8.5 Right, 8.2	Left, 8.1 Right, 8.1	
XVI.	M.	O.R.P.	Left, 9.5 Right, 9.1	Left, 9.1 Right, 9	
III.	P.	O.L.A.	Right, 8.8 Left, 8.	Right, 8.2 Left, 8.1	
IV.	P.	O.L.A.	Right, 8. Left, 7.5	Right, 8.5 Left, 9	Original asymmetry of the parietal regions.
V.	P.	O.L.A.	Right, 9.6 Left, 8.	Right, 9.3 Left, 9.	
VII.	P.	O.L.A.	Right, 8.2 Left, 7.9	Right, 8. Left, 7.9	
XIX.	P.	O.L.A.	Right, 8.9 Left, 8.7	Right, 8.6 Left, 8.6	
XXI.	P.	O.L.A.			Head very symmetrical.
VI.	M.	O.L.A.			Perfect symmetry of head.
X.	M.	O.L.A.	Right, 9. Left, 8.8	Right, 8.8 Left, 8.8	Asymmetry of the occipital and of palatine arch.
XIII.	M.	O.L.A.	Right, 8.5 Left, 8.	Right, 8.2 Left, 8.	Original asymmetry of frontal and of occipital.
XIV.	M.	O.L.A.	Right, 8.5 Left, 8.5		Marked flattening on the right, but parietal bosses on the same level.
XVII.	M.	O.L.A.	Right, 8.5	Right, 8.2	Symmetry of parietal regions.
XVIII.	M.	O.L.A.	Left, 8.3	Left, 8.2	
VIII.	M.	O.L.A.	Right, 9. Left, 8.6	Right, 8.7 Left, 8.7	

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[1] The O.R.P. cases are reduced ones.

CHAPTER V.

INCLINED VERTEX PRESENTATIONS.

REJECTING the obliquity of Naegelé and Dubois, at least at the level of the superior strait, we hold that the head enters the pelvic inlet perpendicularly, *i.e.*, with the sagittal suture in the axis of this strait. Now, it is not always so, and cases occur in which this suture looks toward the front or the back of the pelvis. In other cases, as a result of failure or in exaggeration of flexion, the forehead or the occiput present at about the centre of the pelvis (Vorderscheitelstellung-Hinterscheitelstellung of the Germans). These cases are called inclined or irregular vertex presentations. These irregularities are not important, for, under the influence of the unaided uterine efforts, the inclination corrects itself, the presentation becomes one of the face or of the vertex, and labor is spontaneously completed, as if the head had originally been in the normal position. This is not always true, and the exaggerated inclination of the head may become a real cause of dystocia.

The prognosis of vertex presentations is subject to some uncertainties, but, in a general way, these presentations are the most favorable of all. Aside from the cases in which, rotation failing, the obstetrician is obliged to interfere, labor is much protracted when the occiput rotates backward. The fœtus, in these cases, corresponds to a rigid stem, which must traverse a crooked canal, and, as we will see, the danger for both mother and child increases with the prolongation of labor. Even when rotation occurs, the conditions are less favorable. The head remains elevated, the dilatation of the cervix is less easily accomplished, the membranes rupture earlier, the efforts, and consequently the exhaustion, of the woman are more severe in the first stage. Moreover, since the occiput has to make a longer journey, it is necessary that the pains be more energetic, and it is not rare to see a uterus, exhausted by producing rotation, and thus unable to overcome the perineal resistance, become atonic. In this case obstetrical intervention is requisite to produce expulsion of the head. It is, besides, especially in the posterior positions, that the caput succedaneum, surpassing the limits of the scalp, involves the bones and even the encephalon. (This happens most frequently in contracted pelvis). In occiput posterior labors the perineum is greatly endangered, and it is especially in these cases that complete or central perineal lacerations occur. The treatment will be considered after the subject of labor.

CHAPTER VI.

FACE PRESENTATIONS.

WE have considered the causes of face presentations, and the positions of the face in detail, in the article on Presentations and Positions. Face presentations are rare.

Mme. Lachapelle,	in	15,779	labors,	found	face	presentations	72	times.
P. Dubois,	"	2,022	"	"	"	"	11	"
Braun,	"	7,835	"	"	"	"	44	"
At Wurzbourg,	"	8,514	"	"	"	"	58	"
At Gottingen,	"	7,104	"	"	"	"	29	"
Depaul,	"	16,233	"	"	"	"	93	"
Pinard,	"	81,711	"	"	"	"	330	"

The average frequency thus varies, according to different authors, from 1 in 147 (minimum) to 1 in 247 (maximum). As for the vertex, we admit two chief positions, M.I.R. and M.I.L., with their varieties, *viz.*, anterior, transverse and posterior. The position M.I.R. seems to be more frequent than M.I.L.; according to the following statistics of Madame Lachapelle and Depaul.

	M.I.R.	M.I.L.
Madame Lachapelle,	41	31
Depaul,	57	23

Naegelé states that the face presents always in the left oblique diameter, *i.e.*, in M.I.R.P. or in M.I.L.A. This opinion seems to us to be far too absolute. Our personal observations justify us in concluding that the oblique presentation of the face is much less frequent than the transverse, and that, particularly in original face presentations, the transverse presentation M.I.R. is much more frequent than M.I.L. Although the transverse position seems more frequent in original face presentations, it is not so with secondary presentations. The secondary presentations follow vertex presentations, and, since the presentation O.L.A. is much the most frequent, its transformation into a face case almost necessarily produces a M.I.R.P. The vertex presentation O.R.P. likewise transforms itself into M.I.L.A., and although Naegelé is right in saying that the chin is almost always turned backward in right positions, he is only right in regard to secondary face presentations. As enunciated by himself, his proposition is too absolute.

We will first study the character of face presentations in general, and will then take the most frequent position, *viz.*, M.I.R.P. to represent the mechanism of labor. As stated in the article on Presentation, we take as a landmark on the head of the fœtus, not the forehead, as do certain writers, but the chin, which must necessarily rotate beneath the symphysis in order that labor may be completed.

Diagnosis of Face Presentations.

Before Labor.

Palpation.—Pinard expresses himself thus: "In face presentations, pelvic exploration shows the presence of a large tumor at the inlet, above the inlet, or below the inlet, according to the period of labor at which the examination is made. This tumor seems to occupy only one half of the true pelvis. It is very round, very large and very accessible, on one side, but seems lacking on the other. Placing the hand on the fundus uteri, we find the breech generally on the side where the tumor is more prominent. In order to easily follow and map out the resisting surface, it is necessary to depress the abdominal wall slowly and deeply, for the resisting body seems to retreat into the abdominal cavity, while the small, superficial parts are readily felt by the hand. This results from the torsion of the fœtus on its dorsal plane. In thoroughly exploring one of the lateral planes, we soon find that the most accessible part of the cephalic spheroid is in relation with the back. Moreover, particularly early in labor, there exists between the back and the head a deep furrow, into which the fingers sometimes easily penetrate." Thus, we have the presence of the cephalic extremity at the level of the true pelvis, and prominence of this extremity on one side of the pelvis, the back, corresponding to this projection. According to Budin, we may, in certain cases, feel on the side opposite to the accessible tumor a plainly perceptible, horseshoe-like swelling, the inferior maxillary bone. Pinard and Budin thus think that the diagnosis may be made by palpation alone. We hold the diagnosis by unaided palpation to be very difficult, since special conditions are necessary to thus make it, *viz.*, great laxity of the abdominal walls, thinness of these walls and slight uterine irritability. We hold that, in the great majority of cases, palpation and auscultation must be combined. Palpation shows the presence of a cephalic presentation, the presence of extremities at the fundus, and the side upon which the back is located. But we think that auscultation, combined with palpation, best enables us to make the diagnosis. The fœtus being higher in face presentations than in vertex, the maximum of the heart-sounds is, as Devillier remarked, also higher, *i.e.*, no longer below the line dividing the uterus into two equal parts, but on this line. But, while in flexed cephalic presentations the maximum is heard on the side where the back is, in face cases the maximum is transmitted, not by the back, but by the anterior fœtal surface. There will, therefore, be a lack of agreement between the signs furnished by palpation and auscultation, and this disagreement will not only enable us to recognize the face presentation, but to ascertain whether the chin be on the right or left, and thus to ascertain the position.

To recapitulate: We find the characteristics of a head presentation, but while, in the presentation of a flexed head, we find the maximum of the heart-sounds on the left if the back be on the left, and the reverse if the back be on the right; in the face presentation, with extended head, we find, with the back on the left, maximum on the right, and the reverse. This disagreement between palpation and auscultation suggests the existence of a face presentation, and vaginal touch confirms the suspicion. Vaginal touch is, indeed, the only true means of making the diagnosis of face presentations, and even with this, the membranes must be ruptured, the cervix sufficiently dilated, and the face sufficiently fixed. If labor has just set in and the membranes are intact, the engagement of the fœtus has hardly begun, because of its high position, and the extension of the head having just commenced, we reach the forehead, not the face. Now, since we may feel the anterior fontanelle, the coronal suture may be mistaken for the sagittal suture if we do not advance the finger as far as possible, and the face presentation may thus pass for one of the vertex. When the finger, introduced as far as possible, is made to follow the suture from the anterior fontanelle as a starting point, if the vertex is presenting, we will find that this suture is very long and ends at the posterior fontanelle. If it be a face presentation, the suture is shorter and leads to the root of the nose and to the superciliary ridges, not to the posterior fontanelle. Nevertheless, if the membranes are intact and a little tense, and if the cervix is but little dilated, errors are not always avoidable. If, however, the membranes are ruptured and the cervix widely dilated, the diagnosis is very easy.

2. *During Labor.*

Palpation and auscultation give the signs already mentioned.

Vaginal Touch.—The diagnosis is easy by this means. The face produces sensations peculiar to itself. On one side of the pelvis we find a hard, rounded body, the forehead, upon which we feel the coronal suture, ending at the anterior fontanelle. On the other side of the pelvis, we feel a series of inequalities which, with patience and care, we may clearly differentiate. In the first place, there is, below the forehead, a depression limited by two prominent, curved margins, the supra-ciliary ridges, below which we feel two soft, prominent, rounded tumors, due to the projection of the eyeballs. Between these tumors is placed a depression, and still lower, a triangular prominence, the free base of which, turned away from the forehead, presents two orifices separated by a thin partition. This is the nose with its nostrils. Below is a transverse fissure, bounded by two projecting borders, *viz.*, the superior and inferior maxilla. If we introduce the finger into the fissure, which is the mouth, we feel the tongue. Sometimes the fœtus sucks the finger introduced into its buccal cavity. Finally, the finger, passing over the inferior maxilla, clearly makes out, below the mouth, the prominence of the chin. Even if we cannot reach the lower jaw, the direction of the nostrils will necessarily show the situation of the chin. The complete diagnosis of the presentation simultaneously shows the position. This diagnosis, which is so plain, is yet difficult if the membranes have been long ruptured. Since the face corresponds to the pelvic cavity, the caput succedaneum forms on it, and the œdematous swelling and tumefaction of the face completely alter the sensations afforded by palpation. The cheeks, in fact, being much tumefied, tend to approach each other, forming a furrow, at the bottom of which the nose disappears. The buccal orifice, instead of remaining transverse, is rounded. The swollen lips bound this orifice, and, giving it the appearance of the anus, lead to the erroneous diagnosis of a breech presentation. This mistake has been made by very experienced men. The finger, introduced into the vagina, reaches a cheek which, on account of its softness and the resistance it offers, is taken for one of the buttocks. The furrow separating the cheeks is thought to be the fold between the buttocks and the rounded mouth to be the anus. There is, however, a sign by which the error may be prevented. The anus presents, on its margin, the prominence due to the point of the coccyx, which is characteristic of this region.

MECHANICAL PHENOMENA.

Like the vertex, the head may occupy the positions M.I.R.P., M.I.L.A., M.I.R.A., and M.I.L.P., the right and left transverse positions being a little more frequent than in vertex cases. We shall take as a representative type, for our description, the position M.I.R.P., the most frequent of all.

1. *Position M.I.R.P.* (Fig. 206).—This is the most frequent, corresponding, as it does, to the most frequent vertex position, O.L.A.

Diagnosis.—1. *Before Labor.*—The diagnosis of face positions, before labor, is just about impossible. One can say that the position is right or left, but no more. Palpation, auscultation and vaginal touch simply show the face presentation M.I.R. 2. *During Labor.*—Palpation and auscultation, as before.

Vaginal Touch.—The head is moderately extended at the beginning of labor, and so we reach the forehead, which is nearly in the centre of the inlet. After rupture of the membranes, extension being complete, we find the following conditions: The full face is presenting, the forehead on the left, the chin on the right. The face occupies the left oblique diameter of the pelvis, the bregma being in contact with the anterior extremity of this diameter, the chin being in relation with the posterior extremity, the right sacro-iliac symphysis. The diameter M.B. is in relation with the left oblique pelvic diameter, the bi-malar diameter with the right diameter, and the circumference M.B. in relation with the outlines of the inlet. The nostrils look to the right and backward, the pelvic axis traverses the head in the diameter O.F., the anterior fœtal surface looks backward and to the right, the posterior surface forward and to the left. The right side of the fœtus is forward, the left side behind. We find, here, the six periods or stages, as in vertex cases, except that the first period consists in extension of the head, not in flexion, and that the fourth period consists in flexion, and not, as in vertex cases, in extension. We, therefore, have arranged the following table:

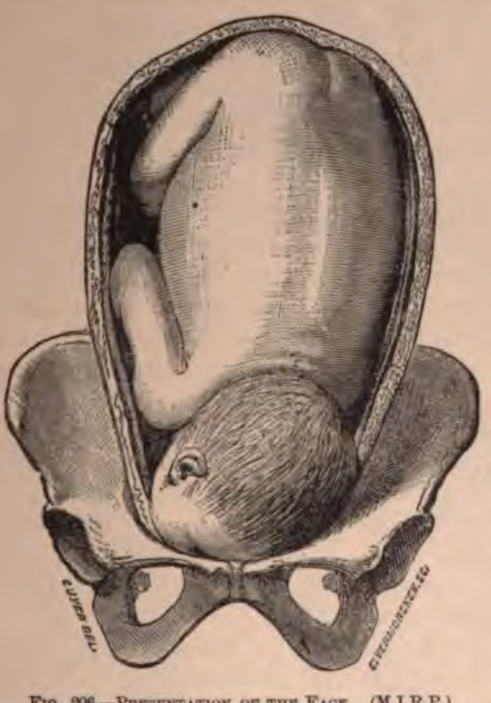

FIG. 206.—PRESENTATION OF THE FACE. (M.I.R.P.)

	Vertex.	Face.
1st period . .	Diminution, by flexion.	By extension.
2d " . .	Engagement or descent.	
3d " . .	Internal rotation (occiput).	(Chin).
4th " . .	Expulsion, by extension.	By flexion.
5th " . .	External rotation.	
6th " . .	Expulsion of the trunk.	

First Period.—Period of Diminution and Completion of Extension.—The first pain, finding the head in a position of well-marked extension, tends to increase the extension, thus depressing the chin and raising the neck on the dorsal side of the fœtus. This movement is not completed until the occiput comes into contact with the back. At the same time the fœtus, bending upon itself, removes its back from the uterine wall, while its anterior surface approaches it. The bregma thus withdraws from the examining finger, while the chin approaches it. The result is, that the mento-bregmatic diameter leaves the superior strait and is replaced by the circumference sub-M.F., the latter diameter, or one very near it, coming to replace the diameter M.B. Now, this diameter, sub-M.F., is smaller than the M.B., and there is, therefore, diminution of the fœtus.

Second Period.—Engagement or Descent.—The head, being thus forcibly extended, engages but does not descend as far as in the vertex presentations, and this depends on the length of the neck. As Cazeaux justly remarks, it is necessary, because of the forced extension of the head, in order that descent may occur, either that the superior part of the chest engage and descend with the face, or that the neck be sufficiently elongated to equal the postero-lateral pelvic wall in length (3.7 inches). If this does not occur, the face can not descend to the pelvic floor. Descent is thus limited and the fœtus remains higher than in vertex cases.

Third Period.—Internal Rotation of the Head.—This movement is indispensable, since it alone allows the head to descend. Bringing, as it does, the chin under the symphysis, it permits the neck to come in contact with the anterior wall of the pelvis, which is only represented by the height of the symphysis. Since the latter is not higher than from 1½ to 1¾ inches, it follows that the neck may adapt itself to this wall and thus permit the expulsion of the chin beneath the symphysis. This rotation occurs more slowly in proportion as the chin is farther back, and it demands, for its occurrence, very energetic pains and normal relations between the size of the fœtus and of the pelvis.

Fourth Period.—Expulsion of the Head.—When the chin has reached the symphysis, the expulsion of the head is easy. The mental diameters do not now engage, but the sub-mental ones. The sub-mental region, situated under the symphysis pubis, is immobilized, like the sub-occipital region in vertex presentations, and it is around this region, acting as a centre, that the head is expelled, in describing the arc of a circle around the symphysis pubis. But the head is extended, and as the sub-mental region and the chin are thus withdrawn from the influence of uterine action, all the force of the contraction is transmitted to the forehead, which is lowered, more and more, by a movement of flexion. The face is then expelled by the successive liberation of its sub-mento-frontal, sub-mento-bregmatic, sub-mento-occipital and sub-mento-sub-occipital diameters, the chin tending to ascend, in proportion as the face is liberated, as we have seen the occiput rise during the expulsion of the head, in vertex presentations.

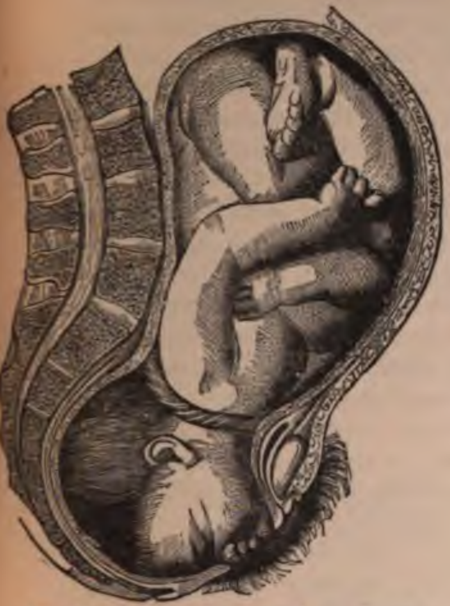

FIG. 207.—PRESENTATION OF THE FACE. (ROTATION ACCOMPLISHED.)

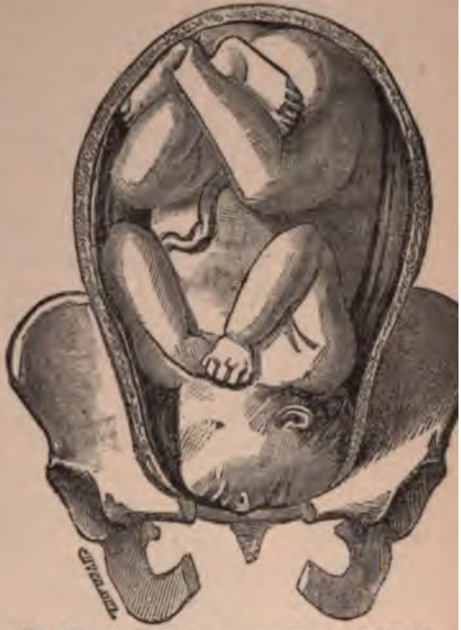

FIG. 208.—PRESENTATION OF THE FACE. (M.I.R.A.)

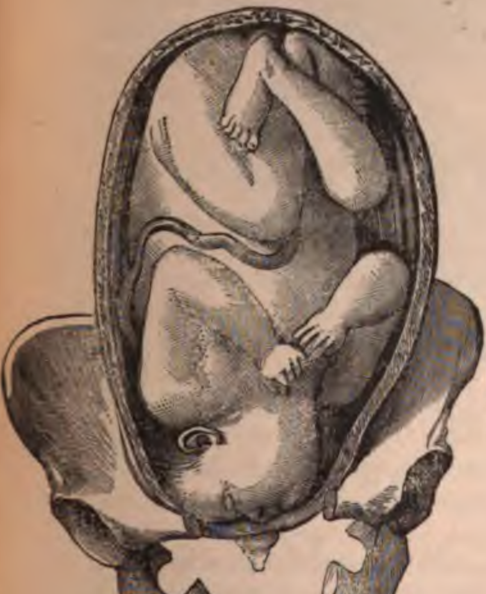

FIG. 209.—PRESENTATION OF THE FACE. (M.I.L.A.)

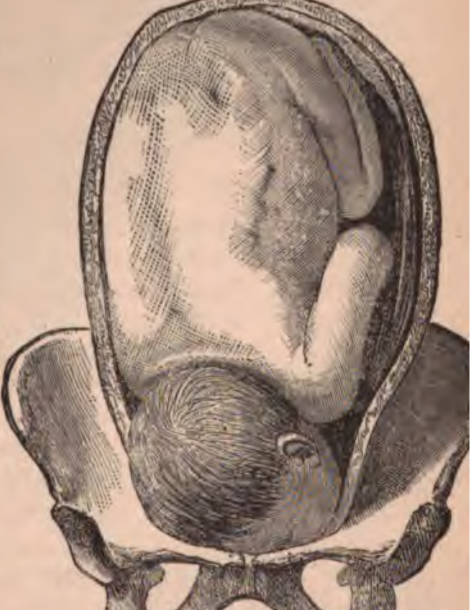

FIG. 210.—PRESENTATION OF THE FACE. (M.I.L.P.)

Fifth Period.—External Rotation.—Sixth Period; Expulsion of the Trunk.—These two periods occur exactly as they do in vertex cases. The shoulders turn within the pelvis, the head turns outside, and the chin returns to the side which it occupied. It thus looks toward the right thigh of the mother, in the position M.I.R.P. The expulsion of the shoulders and of the rest of the trunk occurs just as in vertex presentations.

Second Position M.I.R.A. (Fig. 208)—The chin here looks forward and to the right, the bregma backward and to the left. The head occupies the right oblique diameter,and the nostrils consequently look forward and to the right. The circumference M.B. is in relation with the inlet, the diameter M.B. with the right oblique diameter, and the bi-malar diameter with the left oblique diameter. The periods are almost identical with those of labor in the position M.I.R.P. The only difference consists in the fact that the chin, being in relation with the right anterior half of the pelvis, has a much shorter distance to travel than in the preceding case. The rotation is, hence, easier, and it occurs, as in the position M.I.R.P., from right to left.

3. *Position M.I.L.A.*(Fig.209)—Its relations are the same as those of the position M.I.R.P., excepting that the chin looks forward and to the left, and the forehead backward and to the right. The face is in the left oblique diameter of the pelvis.

4. *Position M.I.L.P.* (Fig. 210)—Same relations as in M.I.R.A. except that the chin is behind and on the left,the forehead in front and on the right, the face occupying the right oblique diameter of the pelvis. The third period is longer, since the chin is behind. Rotation occurs in this case, as in M.I.L.A., from left to right.

ANOMALIES IN THE MECHANISM OF FACE PRESENTATIONS.

Irregularities in the mechanism of face presentations are more liable to occur than in vertex cases, and are manifested in the different periods.

First Period.—The anomalies of this stage are better called deviations from or varieties of the regular face presentations. Thus, in the frontal variety, the brow remains, for a long time, in the centre of the pelvis; in the mental variety, the chin presents. Again, the face is inclined toward one or the other cheek, constituting the malar variety. All these varieties are corrected during labor, but sometimes the first period results in flexion, and not in extension. Then the forehead ascends, the occiput descends, and the face is transformed into a vertex case. This is, of course, a very favorable termination.

Second Period.—Descent is governed, as already stated, by the length of the neck, the size of the fœtus (which is generally large in face cases), the intensity of the pains and the inclination of the presentation, all of which occasion an infinite variety.

Third Period.—Anomalies are most frequent in this stage, and are here of great importance, for rotation must occur in order that expulsion of the head may follow. If rotation does not take place, we may almost absolutely say that spontaneous labor is impossible and intervention necessary. Intervention must often be heroic, involving the application of the forceps and of the cephalotribe. Some authors have, however, cited cases in which labor terminated spontaneously, although rotation had not occurred. Velpeau, who admits a mento-sacral variety, says that the forehead advances to the symphysis, while the chin descends beneath the promontory. The head thus engages in front, as far as just beyond the bregma, and behind, so far that the front of the neck and the upper part of the thorax also enter the pelvis. The diameter O.M. then revolves, from above downward and from behind forward. The chin, penetrating the pelvis, more deeply, and retained by the thorax, which can not advance, forces the sagittal suture to slip behind the pubes, and the brow to move to the upper part of the outlet. The frontal eminences get a purchase upon the perineum, the posterior fontanelle descends, in its turn, appearing at the summit of the arch, and the head escapes as in the occipito-anterior position. With Cazeaux, from whom we borrow this quotation, we call attention to the fact, that the longest diameter which must pass through the pelvic diameter, A.P., is not the diameter O.F.,

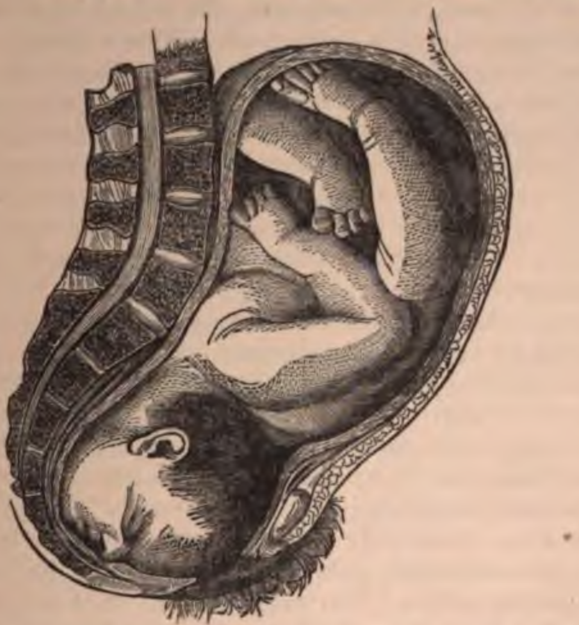

FIG. 211.—PRESENTATION OF THE FACE.—THE CHIN IN THE SACRAL EXCAVATION, AFTER BACKWARD ROTATION.

as Velpeau says, but O.M., which is impossible. This invalidates Velpeau's explanation.

Guillemot admits two terminations: 1. The brow descends until the anterior fontanelle appears beneath the symphysis, when the chin can advance and reach the anterior perineal commissure. As Cazeaux says, it is necessary in order that this be possible, that the thorax and head engage together, which is impossible unless the fœtus be very small. (*Vide* Fig. 211). 2. The face presentation is changed to a vertex presentation. This change, since Guillemot supposes the face to be deep in the pelvis, requires the revolution of the diameter O.M., which is impossible. Cazeaux states that, in these cases, the chin, in the position M.I.R.P., is pushed to the level of the great sacro-sciatic foramen, and there causes depression of the soft parts. This depression will augment the oblique diameter .23 to .31 inches,and will permit the diameter O.M. to revolve and the head to be flexed, which will bring the occiput below the symphysis. The face is thus changed to a vertex case. This is Dubois's explanation, adopted by Tarnier and Chantreuil, except that these authors hold that the chin forms a hollow for itself below the sciatic ligament, on the perineum, which permits of the transformation of the face to a vertex case. Chailly, who admits the mento-sacral position of Velpeau, assumes the descent of the chin to below the coccyx, the depression of the soft parts, the rotation of the diameter O.M., and the transformation into a vertex presentation. The anomalies of the fourth, fifth and sixth periods are the same as in vertex cases.

Prognosis.—The prognosis of face presentations is, therefore, always grave, and if the early writers exaggerated matters in considering spontaneous labor in face cases impossible, Madame Lachapelle fell into the opposite error in saying: "After all, I affirm that, of two patients of equal power, of equally large passages and of similar general circumstances, the one whose child presents by the face will, at least, be delivered just as easily as the one whose child presents by the vertex." Dilatation is slower, the uterine force is less easily transmitted to the fœtus, labor is always much longer, intervention more often required, and the conditions less favorable for the mother. The dangers to the child are much greater. Aside from the cases where, the forceps being inadequate, embryotomy is demanded, the child often dies during labor. While, in vertex cases, the mortality, according to Schroeder, is only five per cent., it is thirteen per cent. in face cases. The frontal variety is the most dangerous. According to Massmann, Hecker and Stadfeldt there were twenty-one deaths among forty-one children. Ahlfeld, however, thinks the prognosis of this variety the most favorable. On the one hand, compression of the neck, produced at the cervix, at the inlet, and particularly at the symphysis, causes cerebral hyperæmia and even cerebral hemorrhage. On the other hand, Tarnier and Chantreuil show that, in face presentations, the cord may be compressed, either because prolapsed (6.3 per cent. in face cases, and 1.8 per cent. in vertex cases, according to Hugenberger), or because, if loops exist, the funis may be compressed between the occiput and the neck.

DEFORMITIES OF THE HEAD IN FACE PRESENTATIONS.

As in vertex cases, the distortions are of two kinds: first, those due to the caput succedaneum, and, second, those due to osseous deformities.

1. *The Caput Succedaneum.*

Since the face corresponds to the pelvic cavity, the caput forms upon it and the face becomes hideous. The child is born with the face almost black, the lips and cheeks swollen, the lids so œdematous that the child cannot open them, and, when the globe can be uncovered, we often find it covered with more or less extensive ecchymoses. The head remains tipped backward for some days. Generally, the caput disappears in three or four days, but the sub-conjunctival ecchymoses sometimes last much longer. It is, therefore, always well to inform the family of the probable appearance which the child will present. Beginning near the mouth, at the angle which was in front, the caput extends to the cheek, the nose or even to the other side.

2. *Osseous Deformities.*

According to Schroeder, the cranial deformity varies in face and brow cases. In face presentations, the cranial vertical diameter is compressed. As a result the vault of the cranium is flattened, while the occiput is retracted and a little elongated toward the neck. The head's right diameter is thus elongated, but the vertical one is lessened. Schroeder admits, as does Hecker, an original dolicho-cephalic head in these cases. In brow presentations the caput succedaneum is on the brow, reaching from the root of the nose to the upper angle of the large fontanelle. The cranium is very high in front, so that the distance separating the brow and the chin is very great, but, from the large fontanelle backward, the parietal bones grow lower, so that, near the neck, the vault of the occiput is very low. The cranium is compressed in the direction of a line passing from the chin to the region above the small fontanelle.

Budin holds that, in face presentations, the diameters O. M. and O. F. are increased, and the angle of the occipital bone bending abruptly forward, its posterior surface becomes more and more convex. The convexity of the frontal is exaggerated, but, as in vertex cases, the free end of the frontal, that which arrives at the level of the anterior fontanelle and of the fronto-parietal suture, allows itself to be depressed, and the diameter sub-occipito-bregmatic is lessened. The normal curve of the parietal bones, at the level of the sagittal suture, is obliterated, and the sagittal border forms an almost straight line between the fontanelles. The maximum diameter either approaches very close to the angle of the occipital, or else is confounded with the diameter, occipito-mental, or evén descends below it. In this case, the maximum diameter is the sub-occipito mental diameter. Tarnier and Chantreuil borrow their description from both Schroeder and Budin.

According to Hecker, to whom we owe the most important monograph on this subject, the crania of children delivered by the face is dolicho-cephalic, *i.e.*, the posterior part is more developed than the anterior.

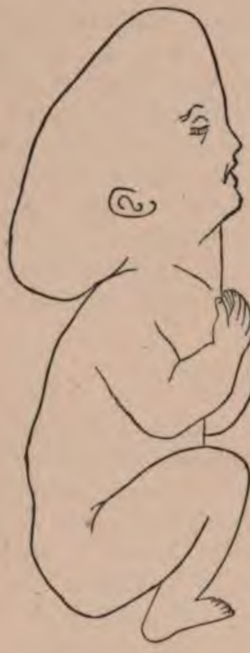

FIG. 212.—DEFORMITY OF HEAD IN CASE OF BROW PRESENTATION.

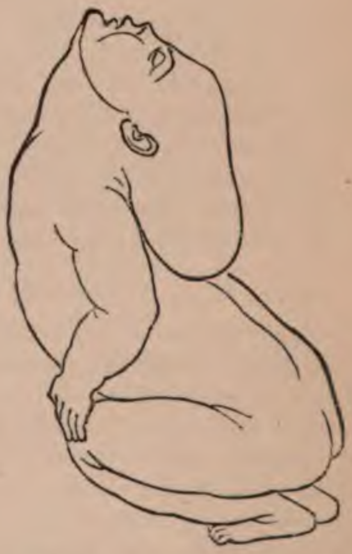

FIG. 213.—DEFORMITY OF HEAD IN CASE OF FACE PRESENTATION.

This is true, but Hecker is wrong in considering this distortion to be the cause of face presentation, whereas it is, usually, the result. We say usually, for certain observations by Hecker show that dolicho-cephalus certainly sometimes exists as a result of cranial developments, and not of distortion after labor. The subjoined table, borrowed from his work "Ueber die Schädelformen bei Gesichtlagen," shows the differences in the crania of children born by vertex and by face presentations.

MEAN MEASUREMENTS OF 8 CRANIA IN FACE PRESENTATIONS, AND OF 12 OTHER CRANIA.

(Hecker, *Die Schädelformen bei Gesichtlagen.*)

Size of the mastoid angle. . .	123°
Posterior arm of lever. . . .	2.
Anterior arm of lever. . . .	2.1
From the anterior circumference of the foramen magnum to the alveolar border of the superior maxilla.	2.2
Length of the occipital, as an arc. .	2.6
Diagonal length of the parietal, as a chord.	3.3
Diagonal length of the parietal, as an arc.	4.
Length of frontal border of parietal.	3.
Length of sagittal suture. . .	2.8
Vertical diameter.	3.2
Transverse diameter. . . .	3.39
Right diameter.	4.251
Diagonal diameter.	4.719
Circumference of cranium. . .	12.597

CHAPTER VII.

PRESENTATIONS OF THE PELVIC EXTREMITY.

The presentation of the pelvic extremity may be complete or incomplete, and may present the two following varieties:

1. *Complete Pelvic Presentation.*—That is to say where the breech presents, accompanied by the inferior extremities, which are in the following relative positions: The thighs flexed upon the pelvis, the legs upon the thighs, the heels in contact with the buttocks and the feet crossed (tailor-fashion). (Fig. 215).

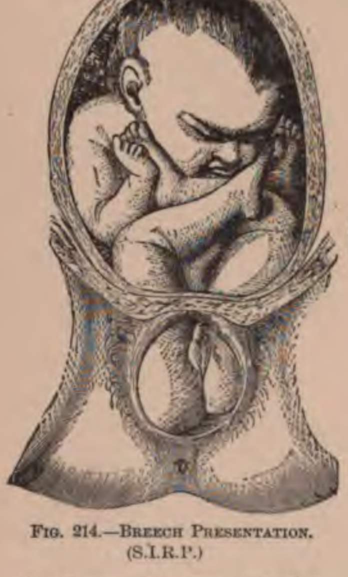

FIG. 214.—BREECH PRESENTATION. (S.I.R.P.)

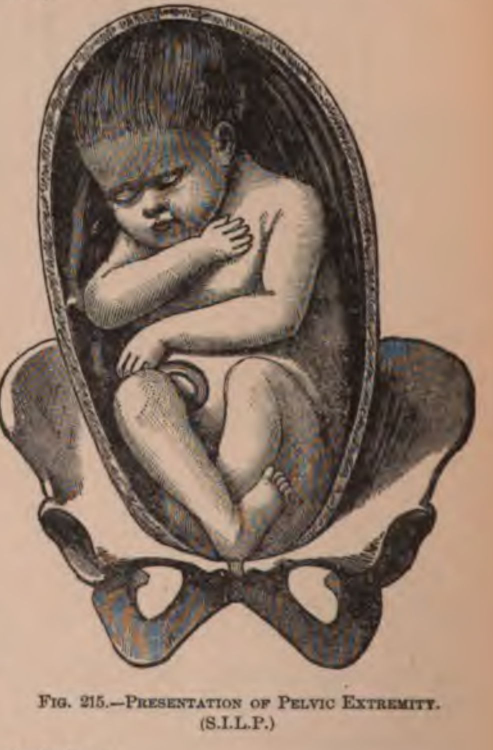

FIG. 215.—PRESENTATION OF PELVIC EXTREMITY. (S.I.L.P.)

2. *Incomplete Presentation.* And then:

α. The breech alone presents, the lower limbs are extended and point upward on the anterior plane of the fœtus, which appears bent double; this constitutes the breech presentation (Fig. 214).

β. The lower limbs are totally extended. The feet first present in the pelvic excavation and at the vulva: footling presentation (Fig. 216).

γ. The lower limbs are but partly flexed, so that the knees first present at the os uteri and at the orifice of the vulva: knee presentation (Fig. 217.)

δ. Finally it may happen that but one foot or one knee alone is flexed, the other inferior extremity remaining extended on the anterior plane of the fœtus; this constitutes a sub-division of either footling or knee presentation.

This state of affairs is of no importance as regards the mechanism, for whatever the variety of presentation, whether the pelvic extremity be complete or incomplete, the mechanism remains the same.

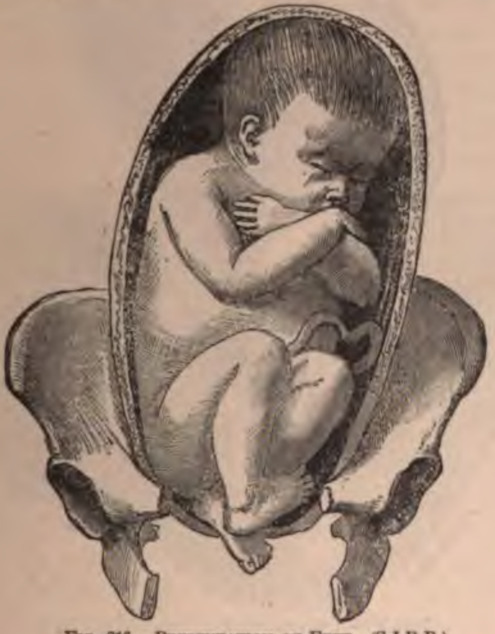

FIG. 216.—PRESENTATION OF FEET. (S.I.R.P.)

Whether complete or incomplete, the pelvic extremity may occupy the two fundamental positions, L or R, with their varieties—anterior, transverse, and posterior; and, the sacrum being taken as the starting-point, we will have to examine the mechanism of labor in S.I.L.A., S.I.L.P., S.I.R.A., S.I.R.P.

The presentations of the pelvic extremity are next in frequency to those of the vertex.

Mme. Lachapelle gives the frequency at 1,390 among 37,895 labors; Dubois 85 among 2,022; Hecker 99 among 8,472; Depaul 633 among 16,233; Pinard 3,301[1] among 100,000; and Mme. Boivin 611 among 20,157.

But the varieties of breech presentations, are not equally frequent.

---

[1] Primaparæ, 1,347; Multiparæ, 1,954.

Thus Dubois found among his 85 pelvic presentations: Breech presenting 54 times. Feet presenting 26 times.

Madame Boivin found among her 611 cases: Breech presenting 373 times. Feet presenting 234 times. Knees presenting 4 times.

Madame Lachapelle encountered only 11 knee presentations among her 37,895 cases of labor, or one in 3,445 deliveries.

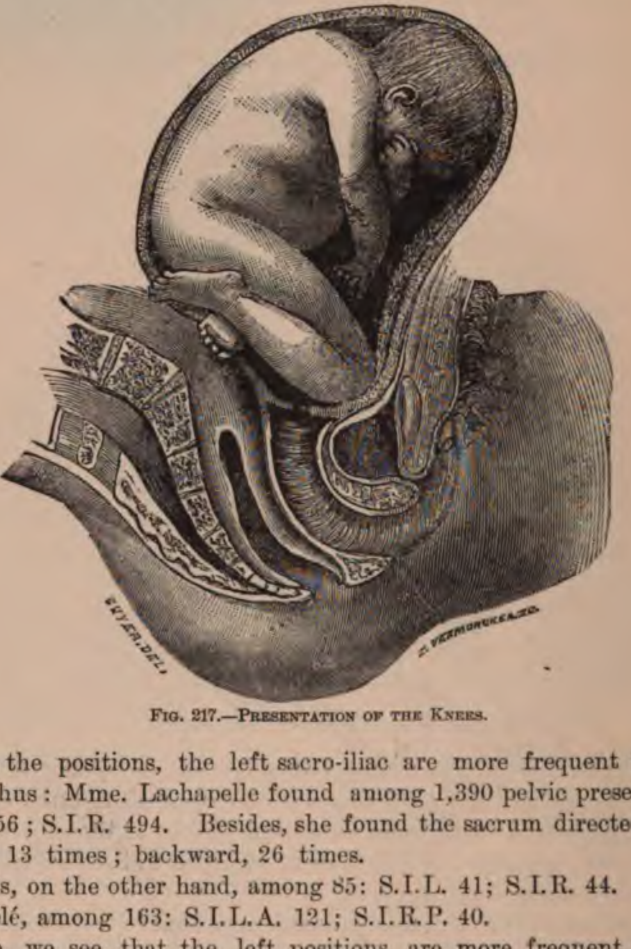

FIG. 217.—PRESENTATION OF THE KNEES.

As to the positions, the left sacro-iliac are more frequent than the right; thus: Mme. Lachapelle found among 1,390 pelvic presentations: S.I.L. 756; S.I.R. 494. Besides, she found the sacrum directed straight forward 13 times; backward, 26 times.

Dubois, on the other hand, among 85: S.I.L. 41; S.I.R. 44.

Naegelé, among 163: S.I.L.A. 121; S.I.R.P. 40.

Hence, we see, that the left positions are more frequent than the right, and the anterior more common than the posterior.

CAUSES.

If the reader will bear in mind what has been said with reference to presentations, the causes of breech presentation can be summarized in a few words: all those which prevent the fœtus from freely accomodating itself to the uterus—in other words, such as prevent vertex presentation (hydrocephalus, twin pregnancy, distention of the uterus, smallness of fœtus, mobility, hydramnios, etc.).

DIAGNOSIS.

The diagnosis must be made before and during labor; but the variety of presentation, some rare cases excepted, can only be ascertained during labor.

Before Labor.

Palpation.—The first sign which attracts attention is, that when the hypogastric region is palpated, the excavation is felt to be empty, and, consequently, that the presentation is elevated. Again, on palpating at or above the level of the superior strait, we find some large fœtal part, and near it we often feel small extremities. On examining the superior portion of the uterus, we find very frequently on one side or the other, about the level of the ribs, a hard, round, prominent tumor presenting the characteristics of the cephalic extremity, and the mobility of which is considerable—this constitutes cephalic ballottement. A resistant surface occupying one of the sides of the uterus, and absent on the other side, indicates the back, and thus the right or left position.

Auscultation reveals the loudest heart-sounds above the line dividing the uterus into the two equal parts, either on the right or left, according to the position.

The Touch.—The presentation being elevated, it cannot be reached; or, as Pajot puts it, "we feel that we feel nothing." The lower segment of the uterus is empty; sometimes, however, by forcibly depressing the fundus uteri, the fœtal extremity, occupying the level of the superior strait, can be brought within reach of the finger, but it is usually impossible to make out its character. In general, it seems softer and less resistant than the head, and in certain cases it is possible to make the diagnosis very well: this is when the small parts which accompany the fœtal extremity are not closely applied to the nates; then these small parts are felt to be movable in the inferior segment of the uterus, they float in the liquor amnii, and the finger, which reaches them, feels them escaping from under it, as if the fœtus had drawn them up; this sensation can be felt only in pelvic presentations.

During Labor.

Auscultation and palpation give the same results as before labor, only the cephalic ballottement is not distinctly perceptible except in the interval between the pains, and even then it is not as clear as before labor.

The Touch.—At the beginning of labor, the fœtal part being high up, the sensations on reaching it are not clear, and the less so when the bag of waters is very large; but the form of the bag (sausage shaped), taken in connection with the elevated presentation, will attract attention. As in all elevated presentations, it is necessary, above all, to avoid rupturing the bag of waters; when it breaks, it generally does so with a snap, and a great deal of water is evacuated.

After the membranes have ruptured and the dilatation has advanced farther, the diagnosis becomes easier. The fœtal portion being more accessible, the finger comes upon a doughy part, behind which it feels a bony resistance; this part might be mistaken, at first, for the vertex masked by an effusion of blood; but, on the one hand, no matter how high the finger may penetrate, or what extent of the fœtal surface it may pass over, it will encounter neither sutures nor fontanelles; on the other hand, the signs perceived are characteristic. For, if the finger is carried beyond the portion first reached, it encounters a groove, on the other side of which can be recognized a part analogous to that first felt; this sensation will be still more distinct if the finger is moved higher up and backward, then gently forward along the groove: it will discover on one side a small, pointed osseous protuberance—the coccyx; in front of it a small corrugated opening—the anus, which always offers a certain resistance to the penetration of the finger. On following the groove still farther, the genital organs are reached, and the sex of the fœtus may be thus determined. This mode of diagnosis requires some practice. Therefore, though for a moment the nates may have been taken for the cheeks, and the anus for the tumefied mouth, the coccyx will prevent the perpetuation of the error. We may add that, when the coccyx is reached, we can nearly always, on following the point of this bone toward its base, run over some portion of the crest of the sacrum, thus confirming the diagnosis. The presentation of the pelvic extremity is thus recognized, and, since the coccyx always points toward the anterior surface of the fœtus, the direction of this bone will give us, not only the presentation, but also the position. Finally, if the finger is introduced into the anus, it will be stained by the meconium. If the feet are pressed against the nates, the diagnosis is still easier. When the feet present, whether applied to the nates or alone, they are recognized easily enough: the heel and the malleoli, in fact, form distinct prominences which exist nowhere but on the foot; the toes too are placed in a straight line, but the signs based on the apposition of the thumb in the case of the hand, and on the shortness of the toes, do not seem to us sufficient. Indeed, if we possessed only these two signs, we would often run the risk of confounding the foot with the hand. We may also insert the finger between the great toe and the second toe and separate them; the distance to which they can be spread apart can hardly be compared with that which can be effected betweeen thumb and index finger, but the tyro is still liable to make a mistake. Also, as regards the toes, all writers lay stress on their shortness, but the sensation imparted is not distinctive; they appear long enough at first, and it might be more truly said, that if the toes seem long enough, the fingers appear of extraordinary length. The thickness of the radial border of the hand has likewise been pointed out as a sign. This may also lead to error unless the accoucheur has had much experience. There is, however, another sign which, if it can be obtained, is characteristic of the foot, but it requires that the greater part of the latter be accessible. It is this: the leg is articulated at a right angle to the foot, while the hand lies in the prolonged axis of the arm, and should the hand by accident be even bent at a right angle to the wrist, such bend will not possess any protuberance comparable with that of the heel, formed by the os calcaneum.

If there be but one foot, it is not enough to recognize it as such, but we must know if it is the right or the left foot. The best plan is, to determine all its characteristics: its great toe, its internal border, and the heel; then to mentally substitute one's own foot for the one felt, in such a manner that, as Tarnier and Chantreuil express it, "the heel, the internal border, and the toes can be, as it were, superimposed over each other." This will show whether the right or left foot has been touched.

The presentation of the knees is so rare that it is hardly necessary to speak of the diagnosis. They form a round prominence, limited behind by the popliteal space, and adjoining the thigh on one side and the leg on another.

The diagnosis of the positions is easy when the presentation is known.

When the breech presents, the direction in which the coccyx points, always toward the anterior plane of the fœtus, indicates which side is occupied by the back. When the breech presents together with the feet, the latter are crossed, and applied, the right to the left buttock, the left to the right buttock, the soles directed backward, the toes of the left foot pointing to the right lateral plane, those of the right foot to the left lateral plane; the heels face in the opposite direction, the right heel to the right, the left to the left side, both turned toward the posterior plane of the fœtus. Hence, if the toes of the right foot point backward and to the left, the back is in front and to the right; inversely, if they point backward and to the right, the back is in front and to the left; if they point forward and to the right, the back is behind and to the left; if they point forward and to the left, the back is behind and to the right. The diagnosis can be reached in like manner from the left foot; here, too, it is best, as in the presentation, to substitute mentally one's own foot for that of the fœtus, and ascribe to it the same attitude; thus it will be seen that, in order to obtain it, one's back will have to be brought to the right or left, in front or behind, as the case may be.

Finally, if the feet alone present, the direction of the heels indicates the side where the back is, and thereby the position.

Budin has recently called attention to a fact which we have also had occasion to verify several times; namely, that the pelvic extremity is not always as elevated as is generally stated, and that it is not very rare to see it so deeply engaged as to be taken for the vertex, on superficial examination.

THE MECHANISM OF LABOR ACCORDING TO THE POSITIONS.

We have said that the mechanism is the same, whatever the variety of presentation, complete or incomplete. Let us take as a type the position S.I.L.A.

Position S.I.L.A.

Diagnosis.—1. Before labor.

Palpation.—The pelvic extremity occupies the left iliac fossa, and the left side of the superior strait, with or without the small fœtal parts; the back is in front and to the left, the head in the right flank, sometimes easily accessible, often hidden by the liver.

Auscultation.—Heart-beats in front and to the left, above the line which divides the uterus into two equal parts.

The Touch.—Fœtal part inaccessible, or barely perceptible.

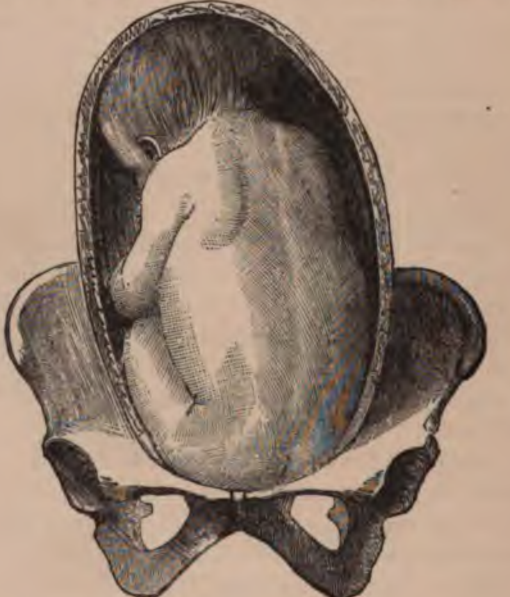

FIG. 218.—PRESENTATION OF THE BREECH. (S.I.L.A.)

2. *During Labor, before the Membranes have Ruptured.*—The same signs on palpation and auscultation, bag of waters sausage-shaped, hardly anything accessible to the finger.

After the Membranes have Ruptured.—The finger reaches the left buttock, then the intergluteal fossa, the anus, and the coccyx, the point of which is directed forward, and to the right. The crest of the sacrum can be felt in front and to the left.

We will now recapitulate the six periods which occur in all deliveries.

First Period.—Reduction in Size.—The fœtus is loosely bent on its anterior plane, the head semi-flexed, the arms and forearms crossed over the chest, the inferior extremities flexed on the anterior surface of the fœtus, its back directed forward and to the left, the left side forward and to the right, the right side backward and to the left, the anterior surface backward and to the right, the intergluteal fossa in the direction of the left oblique diameter, the bis-iliac diameter in the right oblique diameter, the coccyx points backward and to the right, the crest of the sacrum is in front and to the left.

The first period consists in a closer approximation of all the fœtal parts, which exaggerates the flexion of all of these, and brings together the different elements constituting the pelvic extremity; the back of the fœtus curves anteriorly, the head approaches the thorax—in one word, the fœtus tends to occupy a smaller volume, it is reduced in size.

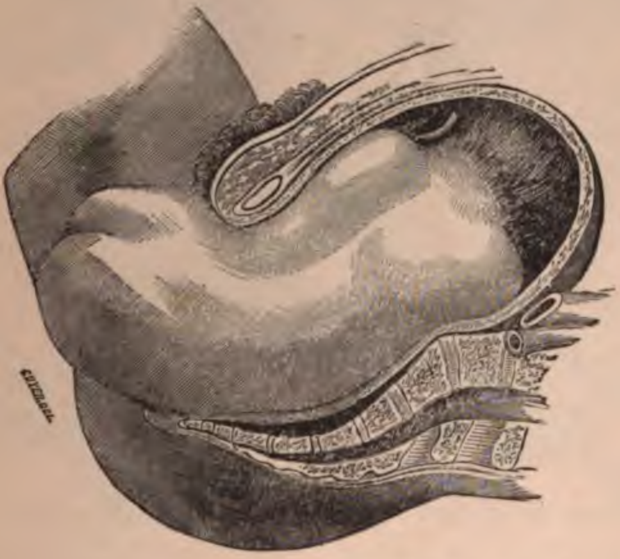

FIG. 219.—DISENGAGEMENT OF THE BREECH.

Second Period.—Engagement.—Thus reduced, the fœtus is engaged in the excavation, but its descent is always gradual. The membranes, in fact, rupture before the dilatation of the cervix is complete, and as this part of the fœtus is less resistant than the cephalic extremity, the influence it exerts on the cervix is less pronounced. The passive dilatation of the cervix being slower, the descent of the fœtal part to the pelvic floor is retarded. While the breech passes through the cervix, we notice the evacuation of meconium, increasing in amount in proportion as the fœtal abdomen is compressed; but in this instance it is of no importance, being due to merely mechanical causes.

Third Period.—Internal Rotation of the Trunk.—The rotation, which is due to the same causes as in vertex presentations, brings the anterior hip (in this case the left) under the symphysis pubis, while the right hip points to the other extremity of the coccygo-pubic diameter. The bis-iliac diameter, therefore, corresponds with the coccygo-pubic diameter, the back is turned full to the left, the anterior plane to the right.

Fourth Period.—Disengagement of the Trunk.—The left buttock being fixed under the symphysis pubis, the right buttock and hip traverse the whole posterior portion of the excavation, and since the right buttock appears first, but remains immovable under the symphysis, we see pass over the perineum, first the right buttock, then the left buttock, next the pelvic extremities, and, if the contractions are vigorous, the arms remaining applied to the chest, the latter descends in turn, the left shoulder appearing first under the symphysis; the right shoulder and right elbow passing first over the perineal commissure.

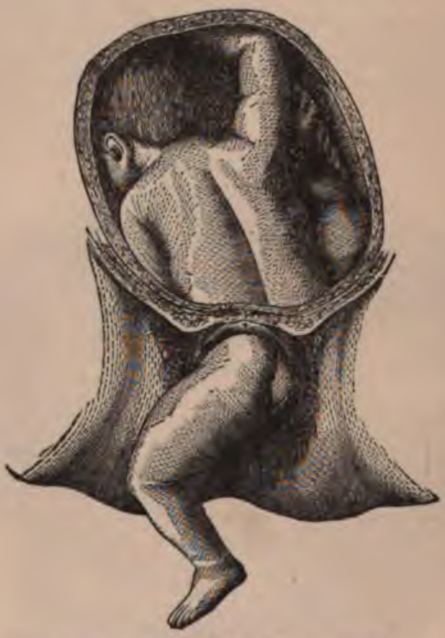

FIG. 220.—DISENGAGEMENT OF LEFT HIP. PROLAPSE OF LEG OF SAME SIDE.

Fifth Period.—External Rotation of the Trunk, Internal Rotation of the Head.—Our object in uniting into one step the external rotation of the trunk, and the internal rotation of the head, is to show more clearly the unity of the mechanism in labor; for generally the external rotation of the trunk is completed before the internal rotation of the head commences. The external rotation of the trunk is usually effected together with the disengagement. In fact, in proportion as the hips become disengaged, they revolve, the left hip approaching the right side, the right hip returning toward the left anterior portion of the pelvis, so that the back, when delivered, is very nearly in the position it occupied within the pelvis; in other words, it faces toward the left thigh of the mother. Ordinarily, the shoulders follow this movement, but in certain cases they partially escape this evolution, so that, while the trunk seems to revolve on its axis, the shoulders are disengaged as we have seen above, and then the head commences its movement of internal rotation. If the uterine contractions are vigorous, the head is flexed more and more, and at the same time the occiput turns and comes to lie behind the symphysis pubis.

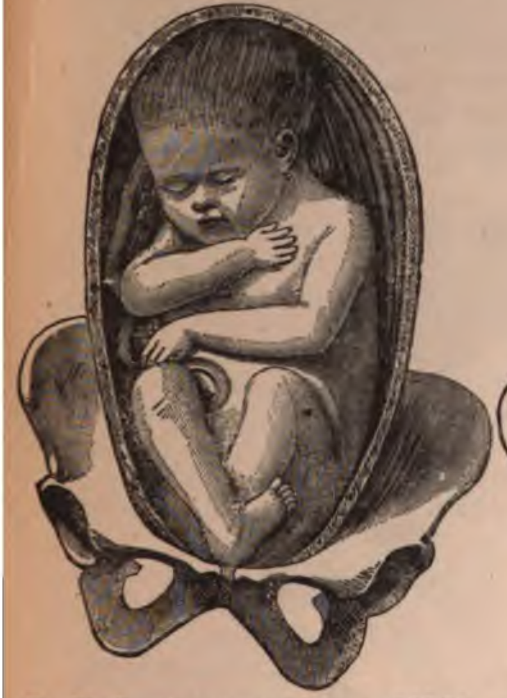

Fig. 221.—Presentation of the Breech. (S.I.L.P.)

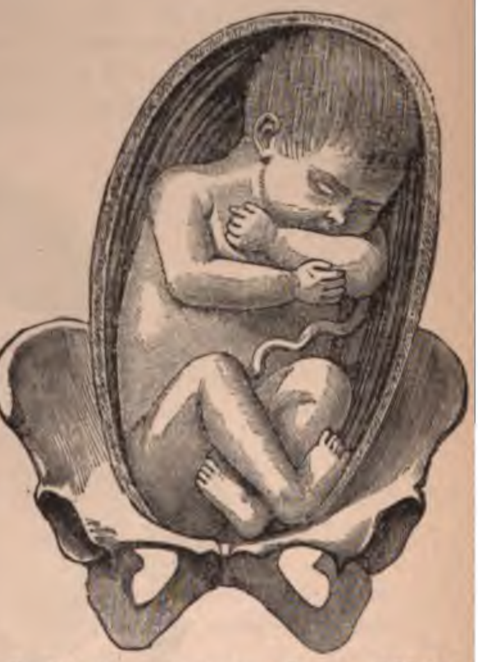

Fig. 222.—Presentation of the Breech. (S.I.R.P.)

Sixth Period.—Evolution of the Head.—The occiput remaining behind the symphysis pubis, the sub-occipital region is kept immovable under the arch, and as the uterine contractions flex the head more and more, the chin is brought successively closer to the chest. One after the other, the following diameters appear: sub-O.M., S.O.F., S.O.B., and finally the occiput, which emerges last of all. The head, therefore, is delivered by its sub-occipital diameters as in vertex presentations.

The Sacro-iliac Left Posterior Position.—(Fig. 221.)

The posterior plane of the fœtus is directed backward and to the left, the anterior plane is in front and to the right, the intergluteal fossa is in the right oblique diameter of the pelvis. The coccyx points forward and to the right, the bis-iliac diameter is in the left oblique diameter of the pelvis. The left hip is directed forward and to the left; the right hip, backward and to the right.

The mechanism is the same, only the third step differs; the left hip executing a much more extensive movement from behind forward, and from the left to the right, so as to come under the symphysis, while the right hip occupies the sacral excavation. The torsion movement of the trunk is therefore much greater. The rotation of the head likewise consumes a longer time, since the occiput has to traverse a greater distance before it comes back under the symphysis. Delivery takes place by the sub-occipital diameters.

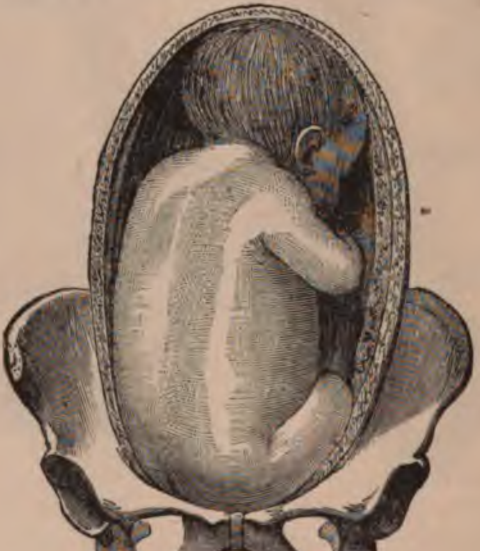

FIG. 223.—BREECH PRESENTATION. (S.I.R.A.)

Position S.I.R.P. (Fig. 222).

The back is turned backward and to the right; the anterior plane of the fœtus, forward and to the left. The intergluteal fossa is in the left oblique diameter; the bis-iliac diameter in the right oblique diameter; the occiput points forward and to the left, the right hip forward and to the right, the left hip backward and to the left; the right buttock is lower, and during rotation places itself under the symphysis pubis. Rotation movement prolonged, owing to the great distance to be traversed.

Position S.I.R.A. (Fig. 223).

The fœtal back is directed to the right, forward, the anterior plane of the fœtus to the left, backward. The intergluteal fossa is in the right oblique diameter, the coccyx points to the left, backward, the right hip to the left, forward, the left hip to the right, backward; the bis-iliac diameter is in the left oblique diameter; rotation, which brings the right hip first under the symphysis, takes place from left to right, while the occiput rotates from right to left.

ANOMALIES AND ABNORMALITIES.

First Period.—As there are oblique vertex and face presentations, so may there be oblique presentations of the pelvic extremity, which give rise to difficulties in the first period, which become greater in proportion as the presentation of the pelvic extremity is less complete. Descent, moulding and flexion of the fœtus will occur more readily in proportion as the component parts of the pelvic extremity are closer together from the onset of labor; and the uterus will exert its force on the fœtus better in proportion as the direction of the fœtus approaches the perpendicular to the plane of the superior strait, that is to say, the axis of the latter

Second Period.—Descent of the fœtus always occurs in pelvic presentations; but, contrary to what might be supposed, this takes place more slowly when the pelvic extremity is incomplete. One might think, since the incomplete is smaller than the complete pelvic extremity, that it should pass more easily; but it is not so, because the dilatation of the cervix and other maternal parts is not so complete. Engagement, moreover, is difficult when the lower limbs are extended on the anterior surface of the fœtus. The most favorable presentation, from this point of view, is when the lower limbs are folded alongside the breech and present with it; this constitutes complete presentation of the pelvic extremity.

Third Period.—The rotation of the trunk may be incomplete, or fail to take place altogether; in fact, it is not indispensable to the disengagement of the trunk. The volume, and the compressibility of the breech, allow it to clear the external genitals obliquely, nor is this occurrence rare, the rotation of the shoulders commencing only after the delivery of the breech. In proportion as the breech and trunk emerge, rotation is seen to take place externally, corresponding to the internal movement of the shoulders. (See Fig. 219.)

The third and fourth periods are, as it were, conjoined. Here, however, an irregularity occurs with sufficient frequency during evolution which constitutes the real irregularity of the

Fourth Period.—This is the extension of the arms alongside the head. When the uterine contractions relax, or are insufficient, the arms are no longer closely applied to the thorax, and the resistance they encounter at the cervix, or the lateral pelvic walls, suffices to produce their extension, and thus causes serious difficulties. This accident is the more likely to occur from attempts at traction on the breech with a view to hasten the delivery, especially when such traction is made during the intervals between uterine contractions.

Fifth Period.—That of internal rotation of the head is the one in which the irregularities are of the greatest gravity, because they give rise to retardation in the delivery of the head, and as the trunk is delivered, the life of the child may be greatly jeopardized. These irregularities may be divided into three classes: 1st. The rotation of the head may take place; but instead of remaining flexed, the head extends, and the chin is arrested behind, either at or below the level of the sacro-vertebral angle. 2d. Rotation does not occur, and instead of again coming to the front, the head remains behind; or else rotation, instead of failing to occur, takes place directly backward in the occipito-sacral direction, when again two conditions may be present—the head is flexed, or it is extended.

It is evident that each of these anomalies usually require the intervention of the obstetrician, and the sixth step, the delivery of the head, becomes artificial. In some cases, however, the head emerges unaided, despite the difficulties it encounters. Let us examine these different cases, and we will confine ourselves here to those in which intervention is called for, leaving the description of the manipulations to the section on treatment of breech presentation.

1st. *Rotation completed.*—Head extended; chin arrested behind; intervention.

2d. *No Rotation, Head flexed.*—The occiput remains almost invariably behind, but as the uterine contractions are vigorous, the head engages as far as possible, the face having adapted itself to the pubic arch, while the occiput comes in contact with the perineum, and the nucha becomes fixed at the posterior commissure of the vulva. The nucha, that is, the suboccipital region, having become fixed, the uterine contractions gradually force down the face, and the posterior commissure of the vulva being forcibly pressed backward, the head emerges by the diameters S.O.M., S.O.F., S.O.B. The occiput is the last to appear.

3d. *No Rotation, Head extended.*—Chin arrested above the pubes, intervention nearly always called for. In some cases, spontaneous termination. Then, in consequence of the contractions, extension of the head is completed; the chin still remaining fixed above the pubes, the occiput, acted upon by the force of the uterus, traverses the entire posterior wall of the excavation, and first emerges at the posterior commissure of the vulva. As the head is delivered by the trachelo-occipital, trachelo-bregmatic, and trachelo-frontal diameters, the forehead emerges last. It is evident that the evolution is much more difficult in these cases, and to render it possible, not only must the uterine contractions be very vigorous, but the fœtus must be small, the pelvis at least normal, and the resistance of the soft parts not very great. (Fig. 224.)

Sixth Period, Delivery of the Head.—Even under ordinary conditions, although rotation occurs and the head is extended, that is to say, independent of the anomalies above enumerated, the disengagement of the head is sometimes delayed and intervention is called for. The procedure we shall learn hereafter.

Prognosis.—It is evident, that the prognosis of pelvic presentations is much graver than that of vertex presentations.

As to the mother, the first period, that of dilatation, is always prolonged, the more so in proportion as the pelvic extremity is incomplete. The fœtal parts being elevated and the bag of waters voluminous, the latter often breaks with the beginning of dilatation; and the fœtal parts being high up, they do not adapt themselves to the lower uterine segment and dilatation progresses slowly. When the buttocks alone present, the fœtus being bent double, the descent is still more retarded, and when the fœtal parts reach the level of the cervix, there is, instead of the hard body formed by the head in vertex presentations, a soft part pressing against the cervix, which likewise contributes to the retardation. It is true, as Cazeaux remarks, that as soon as the cervix is fully dilated, the descent of the breech, trunk, and shoulders is generally rapid, but the head is likely to encounter obstacles and to be arrested at the superior strait. This requires the intervention of the accoucheur, and though it is not dangerous to the mother, it is none the less an intervention. Therefore, we cannot agree

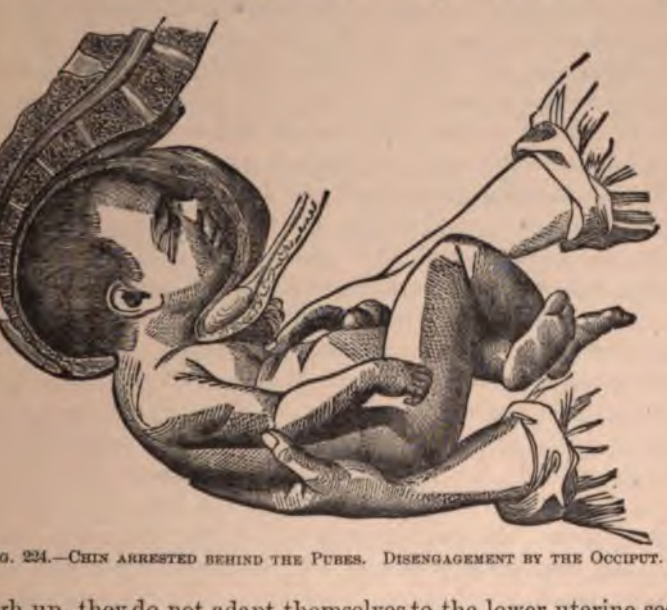

FIG. 224.—CHIN ARRESTED BEHIND THE PUBES. DISENGAGEMENT BY THE OCCIPUT.

with Cazeaux, who says that, as regards the mother, "in podalic presentations, delivery is perhaps more favorable than in those of the vertex." But we fully coincide with him when he adds that "it is certainly more fortunate for her than in face presentations."

In our opinion, delivery by the breech is most dangerous to the mother, and we regret that we must differ in this respect from P. Dubois, who considers it more favorable than delivery by the complete pelvic extremity or by the feet. We are pleased to see that our opinion is shared by Tarnier and Chantreuil.

For the child, the prognosis is always grave; so much so that the younger French school, represented by Pinard, Chantreuil and Budin, advises, almost unanimously, to change the pelvic presentation into a vertex, by external manipulations. We will discuss this opinion hereafter.

But let us add that it is mainly the untimely intervention of the obstetrician which renders the prognosis grave, and if in some cases interference is called for, not only must the necessity therefor be recognized, but also the precise moment be known when it is required. In the great majority of cases it is worse than useless, and especially in presentations of the pelvic extremity must the accoucheur know when to remain inactive. Besides the dangers to which the fœtus is exposed by meddlesome midwifery, there are several others due to the presentation of the pelvic extremity, the greatest of which is undoubtedly compression of the funis.

Yet this compression occurs inevitably at a certain time in pelvic presentations. While in vertex presentations the head, as it comes first, fills the lower uterine segment and passes the cervix and the genital parts, the cord—cases of prolapse excepted—is above this part of the fœtus, and thus escapes compression; but this is far from being the case in pelvic presentations. In the latter, after the breech has passed, the funis is necessarily caught in the excavation, at first between its walls and the trunk, later between these and the head. The cord must therefore undergo compression, which will increase as the labor progresses, because the hardest, most resistant part escapes last. Moreover, the sudden evacuation of the liquor amnii, which occurs in pelvic presentations, tends to draw the cord along, and to make it prolapse in the vagina, where it will be compressed in proportion to the bulk of the part about to descend. Even without prolapsing, in the strict sense of the word, the funis may be compressed either between the back of the infant and the uterine wall, or between the fœtal parts and the cervix. This compression, however, is generally moderate, and it is particularly during the descent of the head that the dangers of compression become imminent to the infant.

Another danger threatening the infant is the extension of the arms, owing to the difficulties their disengagement causes. For it must not be forgotten that, while we are engaged in freeing the arms, the trunk is delivered, the fœtus will make inspiratory efforts, and as the head is still within the uterus, blood and liquor amnii mixed with meconium will enter the respiratory passages instead of air, thus exposing the fœtus to the gravest dangers. (See Podalic version.)

Tarnier and Chantreuil also assign an important part to detachment of the placenta, which may result from uterine retraction, that manifests itself as soon as the head has passed the orifice, and becomes the more dangerous in proportion to the length of time the head is arrested at the level of the perineum. We think these authors attach too much importance to detachment of the placenta; for, if the head is on the perineum, or if it arrives there under favorable conditions, and then emerges soon, the fœtus is safe; if it is there less favorably situated for delivery, the intervention of the obstetrician is imperatively demanded; in either case, if promptly successful, the infant will have escaped the threatening danger, whereas the accoucheur finds himself in the presence of serious difficulties, when the trunk being delivered, the child makes inspiratory efforts, and thereby draws into the air-passages blood or liquor amnii, which seems to us of much greater importance than detachment of the placenta.

This accident, however, may be effected in two ways; either by uterine retraction, or by the traction exercised on the cord by the fœtus; for owing to the not infrequent premature descent of the funis, the fœtus may drive the cord before it, or the cord may be between the fœtal limbs, and especially if naturally rather short, will be pulled the harder the farther the fœtus descends.

Depaul correctly emphasizes another danger to the fœtus: retraction of the cervix uteri upon the neck of the infant; not that the cervix strangles the neck, thus as it were choking the fœtus and killing it by compression of the vessels and congestion of the head, but because "in this engagement of the pelvic extremity, the os uteri need not be dilated *ad maximum* for the passage of the trunk, and, when the neck arrives, the dilatation effected cannot persist, as this part of the fœtus does not suffice to maintain it. The head is, therefore, held back by the cervix enveloping the fœtal neck, in a similar way as a button-hole retains a collar-button." Of course, this accident is the more likely to occur when the uterine contractions are insufficient to maintain the full flexion of the head.

Hence we see that the prognosis of pelvic presentations is always very grave for the child, and, therefore, the rate of fœtal mortality in this delivery must not surprise us.

Mme. Lachapelle had among 804 pelvic presentations: Feeble infants, 102; still-born, 115.

Paul Dubois gives the average as one death to eleven deliveries.

We will see hereafter how the extraction causes lesions in the fœtus, which render the prognosis of pelvic presentations still worse.

FŒTAL DEFORMITIES IN DELIVERY BY THE PELVIC EXTREMITY.

Effusion of Blood.

In pelvic presentations, the caput succedaneum is found on that portion of the fœtus which corresponds to the pelvic cavity, generally the anterior buttock, but it extends also to the genital parts, which are tumefied and livid. When the feet or knees present, the caput is found upon them.

Deformity of the Cranium (Fig. 225).

In pelvic presentations, the head, being but a short time subject to compression, is not generally deformed, and, as Spiegelberg says, it has a characteristic, round, brachy-cephalic form, which is all the more striking because it presents no caput. This rounded shape of the head is explained by the fact that the entire circumference of the cranium is subjected to the pressure of the genital passages, except the vertical region; the occipital, the two parietal, and the frontal regions being equally pressed upward. The parietal bones, owing to their mobility, overlap the other bones as the result of the pressure of the cranial contents upon the vertex (that is, from below upward); this manifests itself by enlargements of the vertical diameter of the cranium, originally oval, while the transverse and sagittal diameters are shortened.

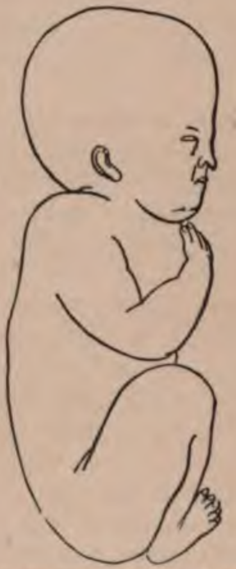

FIG. 225.—DEFORMITY OF THE CRANIUM IN PELVIC PRESENTATIONS.

Hecker relates two cases of breech delivery in which the cranium presented very marked dolicho-cephaly.

CHAPTER VIII.

PRESENTATION OF THE TRUNK.—SPONTANEOUS EVOLUTION.—SPONTANEOUS VERSION.

THE terms, presentation of the trunk, presentation of the shoulder, and presentation of the lateral plane of the fœtus, are used to designate the presentation of the entire fœtal region bordered by the neck of the fœtus on one side and by the crest of the ilium on the other. We have, therefore, two fundamental forms: 1st. Presentation of the right lateral plane, right shoulder. (Figs. 227, 228). 2d. Presentation of the left lateral plane, left shoulder. (Figs. 229, 230.)

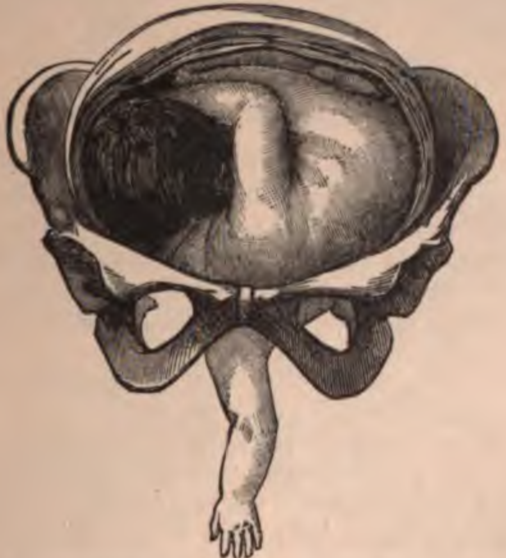

FIG. 226.—PRESENTATION OF THE LEFT SHOULDER WITH PROLAPSE OF THE ARM.

In each of these presentations, the fœtal head may be on the right or left side, thus:

1st. Right shoulder: Head to the right—Cephalo-iliac right of the right shoulder; Head to the left—Cephalo-iliac left of the right shoulder. 2d. Left shoulder: Head to the right—Cephalo-iliac right of the left shoulder; Head to the left—Cephalo-iliac left of the left shoulder.

There are, therefore, two shoulder presentations, but only two positions for each shoulder, for the anterior, transverse or posterior varieties are here of no importance. But the varieties of presentation are more noteworthy. That shoulder, namely, which is the distinguishing point of the presentation, may be relatively distant from the centre of the pelvis, and thus, although it is still the lateral plane of the fœtus, the trunk, which presents, it is not properly speaking the shoulder, but a part dependent upon it, the elbow, which is the most accessible part. We are, therefore, dealing with a variety of shoulder presentations, and for this reason we have, contrary to some authors, taken the head instead of the acromion as the distinguishing point; otherwise this is a matter of little consequence, and a glance at the following table will be sufficiently convincing.

The lateral plane of the fœtus may present in one of the following ways:

1st. Right Shoulder:		
Head right.—C.I.R. of the right shoulder.	Variety	Acromial. Cubital.
Head left.—C.I.L. of the right shoulder.	Variety	Acromial. Cubital.
2nd. Left Shoulder:		
Head right.—C.I.R. of the left shoulder	Variety	Acromial. Cubital.
Head left.—C.I.L. of the left shoulder.	Variety	Acromial. Cubital.

Usually, in presentations of the trunk, the hand and the arm prolapse at a certain time into the vagina (Fig. 226), the same hand protrudes beyond the genitals; but this does not constitute a variety of the presentation. It is a consequence of the presentation which, as we shall see, may be utilized in arriving at a correct diagnosis.

Although rarer than pelvic presentations, those of the shoulder are more frequent than face presentations.

Depaul gives 189 among 16,233 cases of labor; P. Dubois gives 13 among 2,022; Pinard gives 806 among 100,000.

As to the relative frequency, the researches of Mme. Lachapelle show that the right shoulder presents slightly more often than the left; and that the dorso-anterior positions of the fœtus are somewhat more frequent than dorso-posterior positions, in other words, that C.I.R. of the left shoulder and C.I.L. of the right shoulder are the most frequent. The figures obtained by Depaul confirm the above with reference to the presentation. Among his 189 shoulder presentations we find: Right shoulder 75 times; Left shoulder 69.

But his investigations do not agree with those of Mme. Lachapelle in regard to the frequency of dorso-anterior positions; for, taking right and left shoulder together, he found 67 cephalo-iliac left dorso-anterior, to 77 cephalo-iliac right dorso-posterior positio

CAUSES.

The causes of presentations of the trunk (transverse presentations) are those which prevent the accommodation of the fœtus or determine its abnormal mobility, such as some special conformations of the uterus, smallness of the fœtus, premature delivery, hydramnios, fœtal malformations, maceration of the fœtus, faulty insertion of the placenta, multipar-

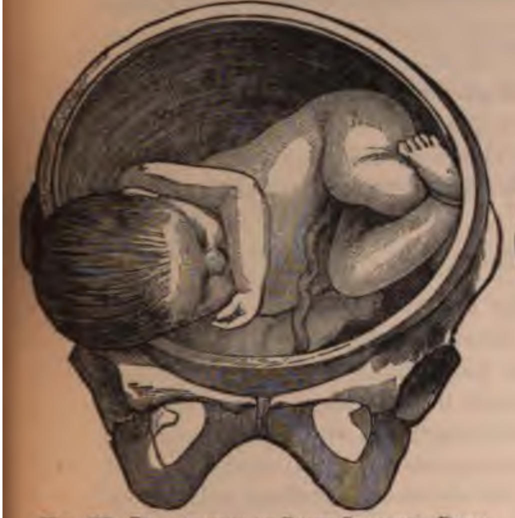
FIG. 227.—PRESENTATION OF RIGHT SHOULDER, DORSO-POSTERIOR.

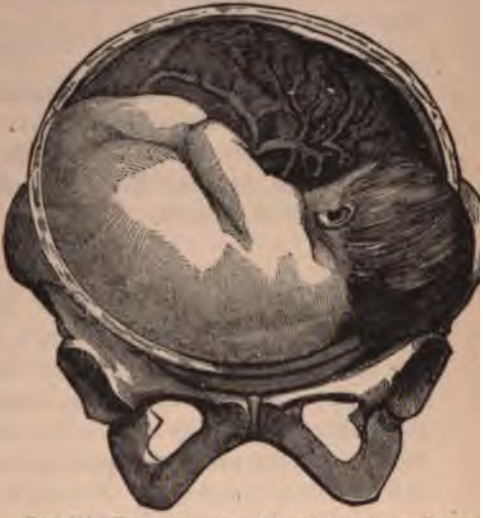
FIG. 228.—PRESENTATION OF RIGHT SHOULDER, DORSO-ANTERIOR.

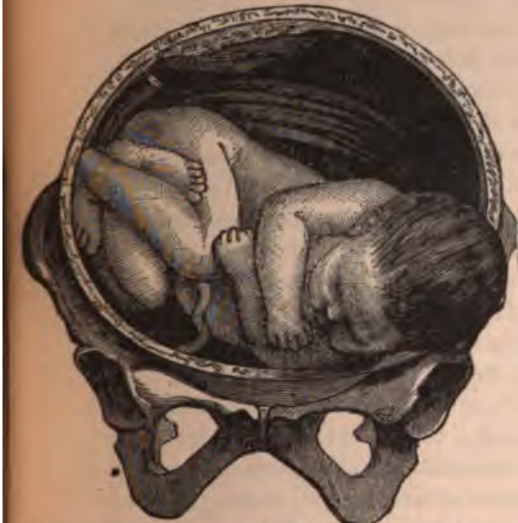
FIG. 229.—PRESENTATION OF LEFT SHOULDER, DORSO-POSTERIOR.

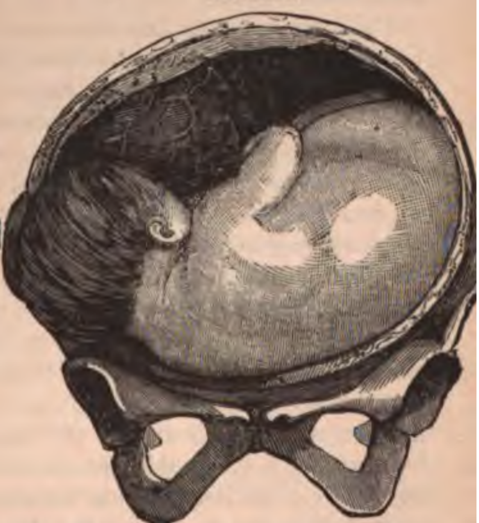
FIG. 230.—PRESENTATION OF LEFT SHOULDER, DORSO-ANTERIOR.

ity, laxity of the abdominal walls (according to Pinard, defective tonicity of the uterine wall), but above all, twin pregnancy and contractions of the pelvis; it is evident that the latter are the two causes which are most likely to prevent the normal accommodation of the fœtus. Polaillon relates a case of shoulder presentation in a malformed uterus, uterus septus.

DIAGNOSIS.

The diagnosis of shoulder presentations comprises three principal points:

1st. Recognition of the shoulder.

2d. Recognition that it is the right or left shoulder.

3d. Recognition that the back is anterior or posterior; that the head is on the right or left side.

Before Labor.

Palpation alone can recognize the shoulder. Indeed, auscultation (although Depaul maintains that in these cases the loudest heart-sounds are heard below or at the level of the line dividing the uterus into two equal parts, but that the sounds diminish in the horizontal, not the vertical direction) is very apt to be misleading; and the touch ascertains merely that the presenting part is high up above the superior strait and inaccessible to the finger. We convince ourselves, therefore, only of the fact that the excavation is empty, a sign which is common to pelvic and face presentations.

Palpation.—Let us first state the fact that, in transverse presentations, the fœtus never lies straight across the pelvis, but always obliquely, one extremity higher than the other, the lowest part being the head, the shoulder being generally in the plane of the superior strait. Hence the shape of the abdomen presents the peculiarity of seeming more distended in the transverse than in the vertical direction. On palpating the uterus, we find that the excavation is empty and that the fundus uteri may be depressed without enabling us to feel therein that resistant body which we are accustomed to find there in longitudinal presentations: that the head is neither below nor above, any more than the pelvic extremity. On exploring the iliac fossæ, we feel in one, at a greater or less distance from the margin of the excavation, a hard, round, prominent tumor which is often movable, especially in multiparæ, and gives the cephalic ballottement more or less distinctly. On moving the hands a little higher or lower on the opposite side, we encounter another voluminous part which is, however, less hard and less movable, near which small fœtal parts are often found: this is the breech. If we depress the uterus in an oblique line from this superior prominence towards the head, we feel the resistant surface formed by the lateral plane of the fœtus, and thus the diagnosis of shoulder presentation is made. For instance, if the head is on the left side, it may be the right or the left shoulder; but if it be the latter, it is not the back of the fœtus which is felt, since this lies posteriorly, but the left lateral plane. The resistance offered by the lateral plane of the fœtus will be very limited. If, on the other hand, it be the right shoulder, the back will be in front and entirely above the superior strait—the resistant surface will be much more extensive and more readily accessible. The same observation is true when the head is on the right side, and we have to deal with the right or left shoulder.

Hence we can thus diagnosticate both the presentation and the position; but this will only be feasible when the abdominal walls are supple, not thick, and the uterus is but slightly irritable, that is to say, not very liable to contract. At all events, if the diagnosis of the position cannot always be made, a great point gained is that the presentation has been clearly recognized, and that is always possible.

During Labor.

In the beginning, although more difficult, palpation is still the best method. The presentation can be recognized during the intervals between the contractions. Auscultation is always unsatisfactory; as to the touch, if the dilatation is somewhat advanced, it may discover a large bag of waters, but the presenting part remains almost inaccessible or at least affords no characteristic sensations. As soon as the membranes are ruptured, however, the diagnosis becomes possible.

Membranes Ruptured.—Owing to the evacuation of the liquor amnii, which is always abundant, the uterus diminishes in volume, applies itself more closely to the fœtus, and hence, as Herrgott remarks, it changes its shape, and tends to reassume the vertical form. As a consequence, the sensations obtained by palpation are somewhat different.

Palpation.—The head has reached nearer to the superior strait, without, however, leaving the iliac fossa, where it is recognized by its form and hardness, but it is no longer movable, cephalic ballottement fails. The pelvic extremity has approached the fundus uteri toward the median line, and the resistant plane uniting these two fœtal extremities has likewise become more nearly vertical, withal remaining more prominent on one side. Thus it seems as if the fœtal trunk had become inclined toward the neck of the fœtus by approaching the head.

Auscultation has slightly changed, the horizontal decrease is no longer present, and the touch gives more definite sensations. The finger comes upon a rounded part with a prominent osseous point, the acromion; on following this part we recognize successively the scapula, its spine, and the clavicle. But to recognize these different osseous prominences requires great experience in the touch, and for our part there is a landmark which outweighs all the others, the axillary cavity formed by the arm on one side and the thoracic wall on the other. Moreover, this thoracic wall presents a series of eminences and depressions arranged parallel to each other like the bars of a grate, which Pajot terms the intercostal gridiron. The ribs being thus recognized, we are sure of having the lateral plane of the fœtus before us. Again, the axillary cavity bounded by the arm and the thoracic wall represents an angle, the point of which is necessarily directed toward the head. It is, therefore, a certain means of indicating the side occupied by the head in cases where it has not been discovered by palpation. The axilla is sometimes difficult to reach in dorso-anterior cases, when the finger must be carried far back, and we can thus always recognize the ribs. In such a case we sometimes encounter the vertebral column of the fœtus, which is marked by the row of projections formed by the spinous processes; on following them, we reach the scapula.

The head being recognized, and the anterior or posterior location of the back determined by the facility with which the ribs may be reached, the diagnosis is complete, that is to say, we know both the presentation and the position.

If we find:

The head to the left, back anterior: it is the right shoulder.
" " " " " posterior: " " left "
" " " right " anterior: " " " "
" " " " " posterior: " " right "

If we know the presenting shoulder and the position of the head, the diagnosis is likewise complete.

If we find:

Right shoulder, back anterior, the head must be on the left.
" " " posterior, " " " " " right.
Left " " anterior, " " " " " "
" " " posterior, " " " " " left.

If, on the other hand, we know the shoulder and the situation of the head, the diagnosis is likewise complete.

If we find:

Right shoulder, head to the left, the back must be anterior.
" " " " right, " " " " posterior.
Left " " " left " " " " posterior.
" " " " right, " " " " anterior.

Hence it is sufficient for us to know two terms of the problem to enable us to find the third. If instead of the acromial variety we have to deal with the cubital variety—in other words, if the elbow is the most accessible part—its recognition is sufficient to establish the diagnosis. The elbow is characterized by the projecting olecranon, limited on its right and left sides by two other prominences, the epi-condyle and the epi-trochlea. The bend of the elbow is formed by the forearm and the arm, and it is only necessary to follow either one of these parts to convince us that it is the elbow we are touching. The forearm will lead to the hand, recognizable by being in the axis of the arm, by the length of the fingers, the apposition of the thumb, and the inequality of the fingers. In order to distinguish which hand we are touching, it is best to determine the characteristics and the situation, and to substitute mentally our own for it. The one we can, as it were, superimpose upon the one felt will indicate whether it is the right or the left hand. This gives us the shoulder, or the elbow indicates the situation of the axilla; in either case the diagnosis is complete. Pajot advises, in doubtful cases, to make traction on the hand felt externally and compare it with one's own; this will show whether it is right or left.

If the hand is outside the vulva, it is sufficient to compare it with either one of ours to show whether it is the right or the left; but there is a more scientific and equally reliable procedure. Take the protruding hand and turn it palm upward, the border inferior to the symphysis pubis; the thumb will always be turned to the thigh homonymous to the hand, to the right thigh in the case of the right hand and *vice versa*. When the shoulder is known, we need but follow the arm to reach the axilla, and thus the situation of the head and the diagnosis is complete.

When the hand depends freely from the vulva, the arm in its natural attitude, simple inspection of the hand will complete the diagnosis.

The hand gives us the shoulder; besides, the back of the hand always turns away from the side where the head is. This gives us two terms of the problem, and we can find the third without difficulty and complete the diagnosis. But examination of the hand suffices.

The hand gives us the shoulder; the dorsum of the hand, the situation of the head; the direction of the thumb indicates the direction of the back; for when the back is posterior, the thumb points upward from the symphysis. When the back is anterior, the thumb is directed downward toward the anus.

MECHANISM OF LABOR IN PRESENTATION OF THE TRUNK.

Presentation of the trunk always calls for the intervention of the obstetrician; its spontaneous termination should never be waited for. Nevertheless, in some cases, Nature may expel the fœtus unaided, and the validity of the law regarding the unity of the mechanism of labor is shown, in that we here find the mechanism identical with that of the other presentations, comprising the six steps which we have thus far encountered in all presentations.

But there is another mode of termination in presentation of the trunk; it is rare, very rare, but is attested by different authors, and consists in the spontaneous transformation of the presentation of the trunk, without intervention on the part of the obstetrician, into either a breech or a cephalic presentation. It is known as spontaneous version.

Spontaneous Version.

In general, the conditions under which spontaneous version may take place are: the beginning of labor, when the contractions are still of little vigor and infrequent, integrity of the membranes, a notable quantity of liquor amnii, a not too voluminous fœtus; in one word, all the factors which give to the fœtus a certain mobility. Under such conditions we can understand how the fœtus, either by spontaneous movements on its part, or under the sole influence of uterine contractions, may be displaced and undergo a change of presentation. We see the shoulder recede from the superior strait, and the head or the pelvic extremity take its place at the level of the superior strait; this is called spontaneous version—cephalic, when it is the head; podalic, when it is the pelvic extremity which is substituted for the shoulder. There is hardly an accoucheur who has not seen similar cases. We ourselves have observed cephalic spontaneous version in a case of fibrous tumor of the uterus. But, what is still more extraordinary is that this spontaneous version has taken place, in some rare instances, after rupture of the membranes, engagement of the shoulder, and even prolapse of the arm and hand into the vagina. The head or breech being thus substituted for the trunk, the delivery proceeds in one of the phases regularly observed in one or the other of these presentations.

Spontaneous Evolution.

But in some cases it has been observed, that, while the shoulder remained the presenting part, the labor terminated spontaneously, and what is still more remarkable, sometimes resulted in the birth of a living child. It is easy to understand how, normally, when the pelvis is roomy, the child small, and the contractions are vigorous, the dead fœtus can be thus expelled; but living! and yet Denman and P. Dubois enumerate some incontestable instances. Of course, in these cases, the labor is always prolonged, but we will see the classical six steps reproduced therein.

First step.—Reduction in size. (*Fig.* 231).—The uterine contractions being uniformly vigorous, and the membranes ruptured long since, the uterus applies itself closely to the fœtus compressing it, rolling it up, and bending it, until the head and breech seem disposed to approach one another. As a consequence, the prominence formed by the shoulders becomes, as Mme. Lachapelle remarks, still larger, and the shoulder appears to be fixed at the level of the centre of the superior strait.

Second step.—Engagement.—Propelled by the violent uterine contractions, this shoulder engages in the excavation, but its descent is naturally dependent on the length of the neck and hence limited. The head remaining at the border of the superior strait in the iliac fossa, the neck is not long enough to reach the full length of the excavation, and as soon as the neck is stretched *ad maximum*, the descent of the shoulder is necessarily arrested.

Third step.—Internal rotation.—After the lapse of some considerable time, during which the fœtus usually succumbs, we observe—although we have some difficulty in understanding it—a movement of rotation, which brings the presenting shoulder under the symphysis pubis. This movement, communicated to the shoulder, being transmitted to the head, the latter glides along the border of the superior strait and becomes fixed above the symphysis pubis (see Fig. 233). Hence the fœtus occupies the following position: immediately above the symphysis pubis is the head, fixed there by the right or left sub-maxillary region, according to the original position of the presenting shoulder. The neck, as in face presentations, is stretched to the height of the symphysis, against the posterior wall of which it is applied. The anterior shoulder is fixed under the symphysis pubis, and the posterior shoulder, with the remainder of the fœtus, is situated in the posterior portion of the pelvis (see Figs. 232, 233).

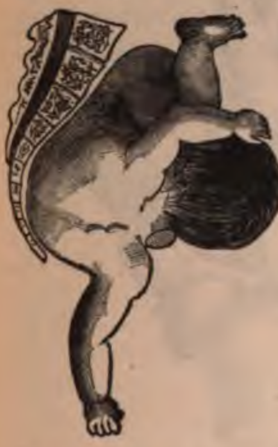

Fig. 231.—First Step.
Reduction.

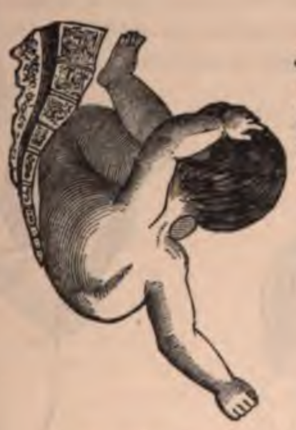

Fig. 232.—Second Step.
Engagement.

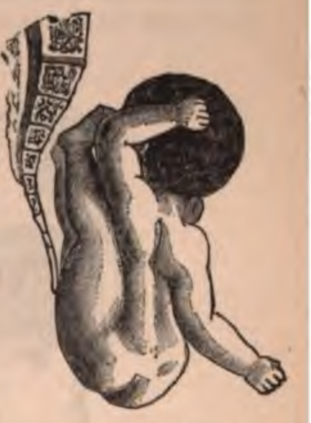

Fig. 233.—Third Step.
Internal Rotation.

Fourth step.—Disengagement of the trunk.—Then begins the fourth step. The anterior shoulder remaining fixed under the symphysis pubis, and appearing first, the uterine contractions force the posterior shoulder (and the rest of the fœtus) from above downward, making it, in its descent, sweep along the posterior wall of the excavation. At last, urged on by the contractions, it distends the perineum, passes the posterior commissure, and is followed by the axilla, the thorax, the hips, the breech; and then the shoulder fixed under the symphysis is disengaged in its turn, while the head remains in the uterus to the last. Properly speaking, there is no such thing as delivery of the fœtus doubled on itself, but a gliding along the antero-lateral portion of the pelvis executed by the posterior-lateral position of the fœtus, of which the superior part—the shoulder—remains fixed under the symphysis, and the inferior part does not come forth until the other side of the fœtus is delivered. Supposing, for example, that the left shoulder is fixed under the symphysis, we see successively evolved over the perineum the right shoulder, the right axilla, the right side of the thorax, the right hip, then the feet, the left hip, the left side of the thorax, and at last the left shoulder; the head alone remaining in the uterus (Fig. 234.)

Fifth step.—External rotation of the trunk, internal rotation of the head.—Then occurs the external rotation of the trunk, which corresponds to an internal movement of the head; the latter readjusting itself, and turning at the same time, in such a way as to put the occiput in direct contact with the superior border of the symphysis, and when this rotation is accomplished, the—

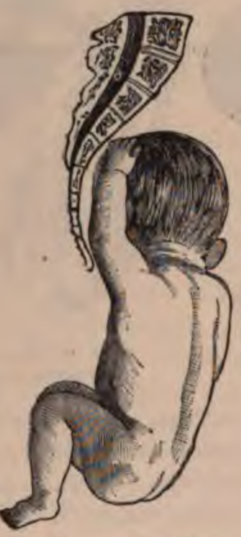

FIG. 234.—FOURTH STEP.—DISENGAGEMENT OF THE TRUNK.

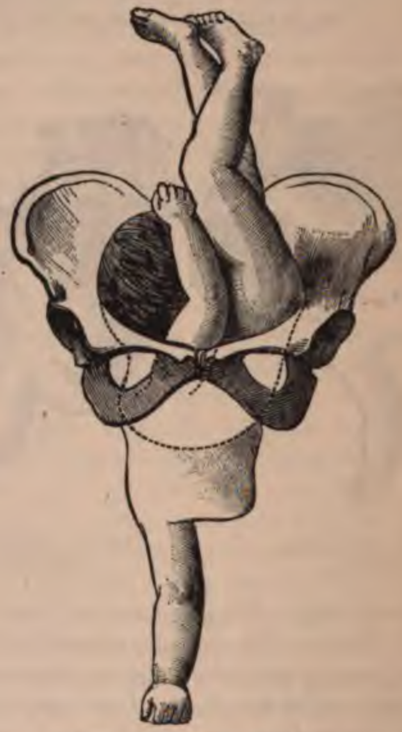

FIG. 235.—INFANT BENT DOUBLE.

Sixth step—Disengagement of the head—is effected as in presentations of the pelvic extremity, by the sub-occipital diameters.

Prognosis.—The prognosis of delivery by the trunk is always very serious. Besides, we must endeavor in every case to recognize this presentation before labor; for, as we will see, we can transform it into a vertex presentation by means of external manipulations. But, if labor has commenced, and external version is impossible, spontaneous delivery should never be waited for, and recourse must be had to version by internal manipulations, which, however, is not always devoid of danger for mother and fœtus. Hence the prognosis is always grave in proportion to the time elapsed since the onset of labor, as the difficulties of intervention increase *pari passu*. Roederer, Kleinwächter, and some other authors, report a few rare cases in which the fœtus in its passage was actually bent double, as shown in Fig. 235.

FŒTAL DEFORMITIES.

Caput Succedaneum.

In presentations of the trunk, the caput occupies the shoulder which corresponds to the pelvic cavity, and when the arm hangs from the vulva, it is often livid, tumefied, and covered with blebs. We must be on our guard not to look upon this as a sign that the fœtus is dead, since it is merely the ecchymosis which produces this appearance, and the heart-beats alone can decide whether the fœtus be alive or dead.

Deformities of the Cranium.

As in breech presentations, the fœtal head is but little deformed and closely approaches the normal type.

CHAPTER IX.

INFLUENCE OF PARTURITION ON MOTHER AND INFANT.

INFLUENCE ON THE MOTHER.

IT is impossible that an act so important as parturition should not react on the economy of the mother and of the infant; hence it should not surprise us to observe the supervention, in the one as well as the other, of functional modifications which we must rapidly pass in review. All the systems, the entire economy of the mother, are more or less influenced by parturition, but only a few of these are more especially involved.

Innervation.

We observe a series of derangements which vary according to the individual. While most women anticipate the end of pregnancy and the beginning of labor with joy, some are anxious, become subject to melancholy and grief, which give place to actual alarm when the first uterine contractions set in. Later, when the labor is fairly under way, this dread disappears in a large majority, and changes in some to apathy, a profound resignation; in others, to irritation, or excitement, which is manifested in words and actions. Thus we find among women a number of varieties, which most frequently depend both on their courage and their nervous susceptibility, but also, it should be added, on the greater or lesser intensity of their pains.

It is indeed incontestable that certain women suffer more than others, and this alone suffices to explain how labor, so well borne by some, gives rise in others to an agitation, a nervous excitement, which may in certain cases be increased to delirium. It is readily understood that primiparity plays a prominent part from this point of view. In general, however, viewed from the nervous phenomena, labor may be divided into two periods which correspond to those of parturition. During the first period, that of dilatation, impatience, agitation, and excitement predominate. Owing to their incapacity to ascertain for themselves the progress of the labor, the women become enervated, agitated, despondent; they express their pains by lamentations rather than by screams or tears—a rebellion as it were, which makes them bewail every pain, and manifest their impatience in a more or less expressive way. Now it is pains in the kidneys, now cramps, now shivering. Nothing is more variable than these nervous phenomena in women, but the most prominent is the feeling of fatigue, which among many finds expression in phrases which are repeated almost periodically, especially in primiparæ, such as: "What time is it?" "Put me to sleep."

As soon as the stage of dilatation is passed, the scene generally changes, and as the expulsive efforts become manifest, it is not unusual for women to bear the uterine contractions much better, although they are much more painful. The woman now feels the progress of the labor; and although she cannot absolutely convince herself of its onward march, she is conscious of it, and it is not rare to see women, until then very excited, take fresh courage, and aid the uterine impulses by their individual efforts. Not until the last pains occur, when the head is about to be delivered, do we see this excessive agitation recur, and then mainly in cases where the head takes a certain time in passing the vulva. Whenever this disengagement is prolonged, we observe that the patients again become irritable, unmanageable, and manifest by screams, sometimes truly savage in their nature, both their suffering and their impatience. In regard to the circulation, we have pointed out the modifications of the pulse during the contraction. But it is a noteworthy fact, that in general the circulation is not accelerated as much as might be supposed. Indeed, the pulse remains usually calm, and even at the height of the greatest efforts of the parturient, it beats generally from 70 to 80; only when the labor is excessively prolonged, in other words when it ceases to be physiological, do we observe an elevation of the pulse, which indicates the pathological suffering of the patient.

Calorification.

It is unquestionable that in the parturient calorification is profoundly modified: even without resorting to the thermometer, it is only necessary to examine a woman during the stage of dilatation, and that of expulsion, to assure ourselves of the fact. During the stage of dilatation, unless there are pathological phenomena, the skin remains cool and the face only expresses fatigue. But in proportion as the stage of expulsion is prolonged, the face becomes flushed, sullen; the pulse becomes strong, tremulous; the skin covered with sweat; and these phenomena are intensified as the expulsive efforts become more forcible, more vigorous, and frequent. Since the use of the thermometer has become a matter of routine, this elevation of temperature has been measured directly; but, strange to say, it is really much less than would be supposed—at least, that is the result of contemporaneous research.

We are indebted to Winckel for the most complete work on this subject. In tracing this question to its source, Winckel shows that Sanctorius in 1638, and Martin, in 1740, were the first to apply the thermometer to the study of human temperature; and to Granville, in 1825, we owe the first observations on the parturient. Home showed that in a normal delivery lasting three hours the temperature of the uterus was: Before labor 108° F.; after labor 105° F. The pulse of the mother was 70, that of the cord 140.

In a delivery at the seventh month, the temperature of the uterus was: Before labor 100° F.; after labor 99° F.

In a forceps delivery which lasted thirty-eight hours: Six hours before delivery, in the interval between pains 118° F.; during strong pains 120° F.; after delivery 110° F.; pulse of the mother, 110.

In a delivery lasting forty hours, the temperature was: Immediately after labor 115° F.

Hohl took the temperature in the hand, the mouth, and the axilla, and found 68° F. in the hand, 95° F. in the axilla, and 91.6° F. in the mouth. He also showed that lowering of the temperature slowed the fœtal pulse, while its elevation accelerated it, but that the relation was not absolute.

Fricke measured the temperature of the vagina and uterus before and during menstruation, and that of the vagina during pregnancy; he concluded from his observations that the vagina is always warmer, not only than the axilla, but even than the uterus.

Gierse denied any influence to menstruation, and declared that pregnancy produced but little change in the temperature.

Bärensprung gave this average temperature of the vagina: Before labor 99.5° F.; during pains 100° F.; after labor 101° F. He showed, besides, that the temperature of the fœtus, taken immediately after delivery, is about 1° F. higher than that of the mother.

Hecker admitted that the normal pains do not elevate the temperature, which rises only when the pains are very strong, and, so to say, insufficient.

Winckel, in 1862, declared that:

1st. In normal labor, the bodily temperature rises slightly from ⅓ to ½° F.

2d. The rise of temperature during labor is not progressive; still, as labor proceeds, oscillations in the normal temperature can be clearly demonstrated.

3d. During labor, oscillations of 1° F. are not rare.

4th. After all normal labors, the temperature rises during the first twelve hours on an average 1° F., and falls in the next twelve hours.

Lehmann, on the other hand, claimed a constant and rapid rise of temperature during labor, proportionate to the intensity of the pains and especially the duration of the labor, to 104° F. and even higher; while it falls immediately after delivery, but still remains higher than during pregnancy.

Schroeder found that during pregnancy the vaginal temperature was on an average 0.182° F. higher than that of the axilla (maximum 0.03, minimum 0.05); that at term the vaginal temperature was on an average 0.278°F. lower than that of the uterus, and he ascribed the greater heat of the latter to the fœtus. During labor, the uterine temperature undergoes a mean rise of 0.165° F., but he was unable to determine any difference due to the pains. Tarnier and Chantreuil, therefore, are in error when they state that Schroeder admits an elevation of one degree during pains.

Schroeder admits that in the parturient female the temperature undergoes diurnal variations. He found:

From	8 P.M.	to	midnight,	100.27°	F.,	mean of	39	observations.
"	midnight	"	5.30 A.M.	100.23°	"	" "	11	"
"	5.30 A.M.	"	11.30 A.M.	100.04°	"	" "	50	"
"	11.30 A.M.	"	3.30 P.M.	100.12°	"	" "	48	"
"	3.30 P.M.	"	8 P.M.	100.43°	"	" "	52	"

The minimum temperature, therefore, corresponded to the time from 5.30 A.M. to 11.30 A.M. Moreover, the temperature of parturients presents many individual variations, independent of pathological states, it oscillates between 98.6°—102.2° F.

Gruber measured the temperature in the vagina, and arrived at the following conclusions: mean temperature during pregnancy, morning, 99.48° F.; evening, 99.2° F.; during labor 99.35° F.

Moreover, far from rising during labor, the temperature seems to fall, and he obtained the following figures, of mean temperature:

No. of cases.	Pregnancy.		Labor.		
	Morning.	Evening.	1st stage.	2d stage.	3d stage.
22	99.48°	99.2 °	99.64°		
30	99.48°	99.25°		99.43°	
28	99.46°	99.25°			99.35°

Mean temperature during pregnancy, morning 99.43° F.; evening 99.25° F.; almost immediately after delivery 99.71° F.;

He concluded from these figures that the temperature rises very little during normal labor.

Winckel, finally, went over the whole ground again, and arrived at the following conclusions:

1st. The rise of temperature in normal labor oscillates between 97.88° and 100.4° F. The average is 99.4° F.

2d. The temperature of a parturient in good condition is slightly higher than the normal human temperature, but this excess of temperature is small and does not exceed on an average 0.3 to 0.5° F.

3d. The temperature in normal parturition is higher than during normal pregnancy; this excess of temperature is on an average 0.02° to 0.04°.

4th. The course of temperature in normal labor corresponds to the diurnal curve of ordinary temperature. It shows two maxima: from 8 to 10 A.M.—99.68°, from 4 to 8 P.M.—99.71°; and two minima: from 12 noon to 2 P.M.—99.44°, from 2 to 4 A.M.—99.26° F.

5th. The difference between the maximum and minimum in the parturient, is like that existing in a non-gravid female in good health; it is on an average 0.27° F.

6th. During the stage of expulsion the temperature seems to rise a little higher than during the stage of dilatation, but the difference is insignificant: from 99.419° to 99.476° F.

7th. There is no difference between primiparæ and multiparæ regarding the temperature, and the maximum or minimum.

8th. Immediately after parturition and delivery, the temperature, as compared with that during labor, varies according to the time of day when it is taken; that is to say, it diminishes at the hour when the normal remission occurs, and rises corresponding to the regular diurnal elevation.

9th. Immediately after labor, the temperature rises above that during delivery, but the difference is very slight.

10th. As in women in health, the temperature of the parturient female in good condition is much more constant than pulse and respiration.

Peter, who measured the uterine temperature before, during, and after labor, arrived at the following conclusions:

In women at term, the intra-uterine temperature oscillates about 99.86° F.; that is to say, it is 0.36° F. higher than the normal intra-uterine mean in a state of vacuity, which is, 99.5° F. The axillary temperature remains normal. During labor, the temperature of the uterus increases on an average by 0.9° F.; that of the axilla by 0.36° F. After delivery, the mean uterine temperature is 100.7° F.; or 1.26° higher than the normal mean, or 0.9° F. higher than before labor.

According to Hennig, the intra-uterine temperature rises during the contraction, at most by 0.18° F., and the axillary temperature also rises during the contraction, while Frankenhauser states that it diminishes.

Respiration.

The following conclusions are likewise drawn by Winckel:

1. The frequency of respiration in parturients is greater than in pregnant women, and in women not in labor, 20.7 to 18.7.

2. The frequency of respiration is notably greater in the intervals than during the contractions. The difference between these two states is 6.8 per minute.

3. Respiration remains normal in the ascending period of the contraction. It diminishes at the acme, to become accelerated in the declining period of the contraction.

4. Respiration goes on accelerating in the intervals of contractions, in proportion as labor progresses and the contractions become stronger; on the other hand, it diminishes all the more during the contraction.

5. The mean in primiparæ is 21.5, in multiparæ 20.4.

6. The frequency of respiration runs parallel to the elevation of temperature; it diminishes as the temperature falls.

Digestive Functions.

The digestive functions, usually little interfered with at the beginning of labor, participate in the general disturbances parturition impresses upon the system. Some patients are tormented with nausea and vomiting from the onset of labor; in others, vomiting is altogether absent, but it is frequently observed at the time dilatation is completed, and also when the head passes the cervix.

Finally, Gassner has shown by his observation on one hundred and ninety cases, that a woman loses on an average, in consequence of parturition, fourteen and a half pounds of her weight, or almost the ninth part of the weight of a pregnant woman who reaches the tenth lunar month of pregnancy (a mean of 10.45 per cent.). This figure represents the weight of the ovum, of the blood lost during delivery, of the excrement expelled during the labor, and the cutaneous and pulmonary exhalations. After twin pregnancies, the loss amounts to 13.2 per cent. It is less in primiparæ than in pluriparæ (Naegelé and Grenser).

INFLUENCE ON THE CHILD.

The fœtal circulation and respiration are chiefly influenced by labor. During the contraction, the fœtal pulsations are at first accelerated, then they diminish in frequency, and even cease altogether when the contraction is prolonged and vigorous. As the fœtal respiration is intimately connected with its circulation, interference with one unfortunately implicates the other. Under normal conditions, the fœtus within the uterus is in a state of apnœa, and it is only when its utero-placental circulation is interfered with, and the oxygenation of its blood thus prevented, that the fœtus endeavors to supplement this placental respiration by inspiratory efforts. But the latter cause the penetration into its respiratory passages of liquor amnii and meconium instead of air, and seriously jeopardize its life. Still, in certain cases, especially face presentations, where the mouth of the fœtus is in line with the anterior part of the vagina, when the fœtus makes respiratory efforts before being delivered, its air passages may aspirate a certain amount of air, which, though minimal, may suffice to save its life. It is in these cases that a peculiar phenomenon has been observed which has been termed the intra-uterine cry. The infant, still within the maternal organs, cries before being born. Though so rare that it has been disputed by Velpeau, this intra-uterine cry may occur, for it has been most precisely demonstrated by Baudelocque, Huguier, Depaul, Hubert de Louvain, Heyfelder, and Winckel.

CHAPTER X.

DURATION OF LABOR.

THE conditions which influence the progress of labor are so numerous and varied that it is very difficult to assign to it an average duration, particularly because different authors do not calculate this duration in one and the same way. Some writers include in their figures all the precursory phenomena, others leave them altogether out of consideration. But above all, two facts can be demonstrated: 1st. While some women have a rapid delivery, others give birth to their children with extreme slowness, and this independent of any complications. 2. Primiparæ almost invariably bear much more slowly than multiparæ. This latter fact is so marked that, reckoning parturition as beginning with the first pains, and counting the number of hours necessary to effect expulsion, we can say that in primiparæ the mean is from twelve to fifteen hours; in multiparæ, from six to eight hours. The same stages of labor are not of the same length in these two classes, and this is self evident, since the perineum and vaginal orifice offer a much greater resistance in the former than in the latter, and considerably prolong the second stage in primiparæ. The same is true of the first stage. There is hardly an accoucheur who has not experienced that truly exasperating slowness with which the dilatation of the cervix proceeds in certain primiparæ, while ordinarily it takes place more regularly and sometimes quite rapidly in multiparæ. Even this dilatation does not proceed in a strictly progressive manner, for in primiparæ it takes nearly twice as long for the cervix to dilate to the diameter of a silver dollar, as it does from that width to complete dilatation; and in multiparæ it is not unusual to see the cervix, after having dilated to the size of a silver dollar, give passage with one or two pains to the head and trunk of the fœtus, the delivery terminating in a quarter of an hour, or an hour at most.

Cazeaux ascribes some importance to heredity, and Depaul to race and climate. According to him, the Flemish, Alsatians, and Germans have a slower delivery than the French. Burns had also maintained that Americans, Persians, and Africans have a more rapid delivery than Europeans. Country women have a shorter labor than city women. But it is impossible to lay down a positive rule in this respect, and the accoucheur must never presume to predict the end of her delivery to his patient. Not even the rupture of the membranes can serve as a certain guiding point in this respect, for we have seen above, that, according to Churchill, among 814 women the termination of labor after the rupture varied from one to one hundred and fifty hours. Still, in in a general way it may be admitted that, in primiparæ and under normal conditions, the termination of labor is accomplished within four or five hours, and in multiparæ within an hour after rupture of the membranes. But this termination may vary from different causes—size of the fœtus, presentation, position, uterine contractions, etc.

Much difference of opinion also prevails regarding the influence of age: some consider that advanced age of a woman at her first delivery is a cause of tardy labor; others look upon this circumstance as of no significance. Still, it is an incontestable fact that very young subjects have generally a much more rapid delivery than others. We ourselves had opportunities of seeing a certain number of very young women delivered rapidly. One of these women was little more than a child. There were:

1. At 13 years and some months	1 case.
2. At 14 years and six months	1 case.
3. From 15 to 16 years	2 cases.
4. At 17 years	1 case.
5. From 17 to 18 years	5 cases.
	10 cases.

All these women had not only natural, but rapid deliveries.

The view that labor is protracted in old primiparæ was disputed by Mme. Lachapelle and Cazeaux, but has been again advanced in 1872 by Cohnstein and Ahlfeld.

Coccio occupies a slightly different standpoint, since his studies were confined to the innocuousness of labor in old primiparæ, and not to the duration of labor; but he admits implicitly that labor is protracted, for he says with Pajot: "These difficulties in parturition are not due, as the older authors maintained, to ankylosis of the coccyx, but to the stage of dilatation which is prolonged, and to the resistance of the soft parts; there is, if I may be allowed to use the expression, a sort of general cornification."

While admitting all this in a general way, we believe that ankylosis of the coccyx sometimes plays a prominent part. We recently had a very good example of this. The case was that of a primipara aged thirty-six years, in whom we were permitted to demonstrate this ankylosis of the coccyx directly, the head being unable to pass it. We were obliged to apply the forceps, and for nearly six weeks the woman suffered a fixed pain at the level of the coccygeal region, which was undoubtedly due to the injury inflicted on the sacro-coccygeal articulation by the head at the time of its disengagement.

CHAPTER XI.

MULTIPLE DELIVERY.

WE have above discussed the means of recognizing twin pregnancy. We need not repeat this subject here, but before examining the peculiarities presented by twin delivery, it will be well to point out the frequency of irregular presentations of the fœtus. Since the accommodation of the fœtus is rendered more difficult, such irregular presentations are self-evident. On referring to the statistics, we find that the children may present in the following modes:

Presentations.	Cazeaux, 285 deliveries.		Depaul, 138 deliveries.		Kleinwächter.
Both vertex	134 times,	47 per cent.	64 times,	46.7 per cent.	49 per cent.
Both breech	33 "	11 "	15 "	10 "	7 "
The 1st vertex The 2d breech	55 "	40 "	29 "	33.5 "	
The 1st breech The 2d vertex	60 "		17 "		
The 1st breech The 2d shoulder	1 "		2 "		
The 1st vertex The 2d shoulder	1 "		7 "		
The 1st face The 2d vertex	1 "		1 "		
The 1st vertex The 2d face			2 "		
Both shoulders			1 "		

TABLE OF TWIN PRESENTATIONS (DEPAUL), 138 CASES.

Both vertex		52 times.
The 1st vertex	the 2d breech	25 "
The 1st breech	" 2d vertex	17 "
Both breech		10 "
The 1st vertex	the 2d shoulder	7 "
" " "	" " vertex with hand or arm	8 "
" " "	" " " and feet	2 "
" " "	" " breech " "	2 "
" " breech	" " shoulder " "	2 "
Both footling		3 "
The 1st vertex	the 2d footling	2 "
" " " with hand or arm;	" " vertex	2 "
" " "	" " face	1 "
" " "	" " " with feet and hands	1 "
" " breech	" " knee " " or "	1 "
" " "	" " breech with feet	1 "
" " face and hands	" " vertex	1 "

In twin pregnancy, parturition frequently occurs before term. Depaul says, "twin delivery most commonly does not differ from single delivery, except in that the series of phenomena which precede and accompany the

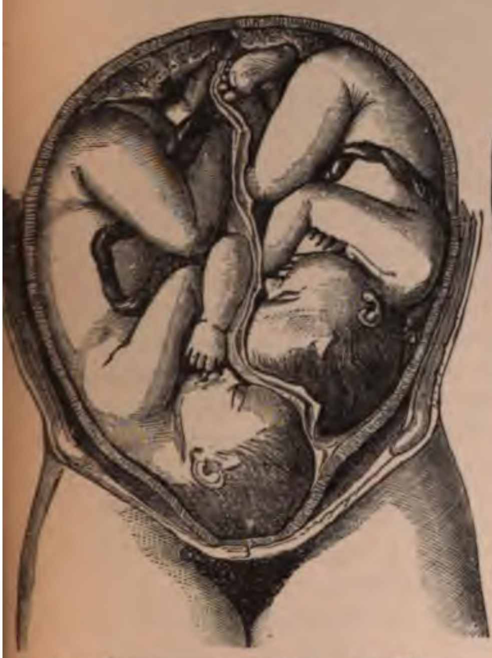

FIG. 236.—BOTH FŒTUSES PRESENTING BY THE VERTEX.

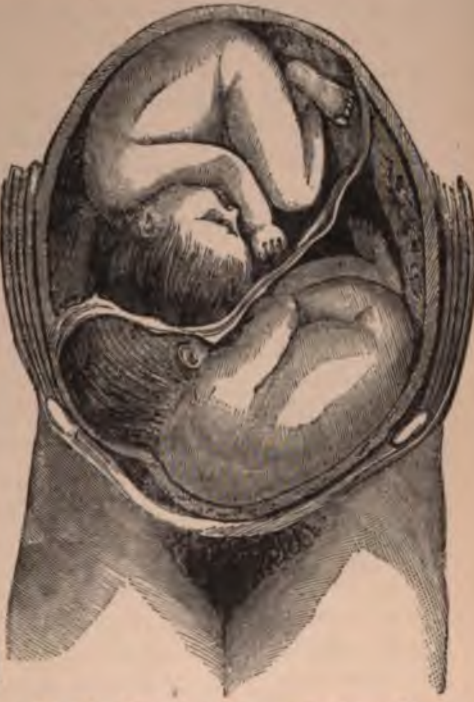

FIG. 237.—ONE FŒTUS PRESENTING BY THE VERTEX, THE OTHER BY THE SHOULDER.

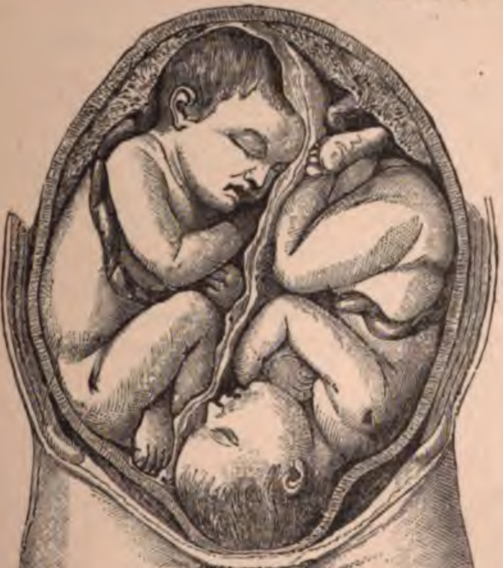

FIG. 238.—ONE FŒTUS PRESENTING BY THE FEET, THE OTHER BY THE VERTEX.

birth of the child in the latter, are reproduced twice in the former." Still we see, according to the above tabulation, that irregular presentations are frequently encountered and the intervention of the obstetrician is often required. Besides, even in cases where the presentation is regular, the course of labor is not rarely modified. In the first place, the uterine contractions may be feeble during the stage of dilatation, a fact attributable to the excessive distension of the organ, and liable to pass away after the first bag of waters has ruptured, but which sometimes persists throughout the entire labor. Moreover, this excessive distension of the uterus leads to inertia of the organ after delivery, and also predisposes to hemorrhage during and after parturition. In the majority of cases, after the birth of the first child, the uterus rests a little while, a quarter of an hour, a half-hour, or an hour at most; then labor is resumed and the second fœtus expelled. But this is not always the case, and in certain instances the interval which separates the birth of the two children may amount to several hours, several days, and sometimes even some months.

We have alluded to these facts in the article on "Super-fœtation." The course to be pursued in twin births, as well as the delivery and dystocia, will form the subject of separate chapters.

CHAPTER XII.

CARE OF THE MOTHER AND INFANT DURING LABOR.

Care of the Mother.

THE attentions which the accoucheur has to give to a woman in labor are so intimate in their nature, so delicate, that the first duty which the attendant must impose upon himself is, to respect as much as possible the sense of shame, and the sensibility of his patient, hence to proceed always with patience and gentleness, to spare the woman all unnecessary examination, not to expose her person except when forced to do so, that is to say, at the end of labor, when the perinæum must be watched. However great the repugnance of the woman, he must not hesitate then; and though in multiparæ delivery under cover is strictly possible in certain cases, we proscribe it positively in primiparæ [The better rule is never to allow the presenting part to emerge, except under the eye—Ed.] It is utterly impossible to watch the perineum with the necessary care unless it is fully uncovered, and women must be made to understand the importance of this supervision, which they yield to without opposition after a certain time. During the course of labor, however, we must abstain from every unnecessary examination, and repetitions should be avoided as much as possible.

Along with patience and gentleness, the accoucheur must possess coolness and decision. His coolness, his calmness, will permit him to resist the pressure brought to bear upon him by the surroundings of his patients; his calmness will make him accept patiently all those more or less odd demands to which he is obliged to respond; and his decision must be absolute with him. Indeed, in certain cases, he must know how to combat the resistance of the patient or her family, and to assume the responsibility of an intervention which the surrounding friends may stupidly dispute, but which may occasionally save the mother and the child.

There is one point upon which we cannot lay too much stress, and that is cleanliness; not the ordinary cleanliness which consists in having clean hands, but one which extends to all the details, even to the linen and the instruments. Modern research has clearly demonstrated that, although auto-infection occurs in lying-in women, the accidents to which they are subject are much oftener the result of communicated infection, of contagion. It is not enough that the hands or instruments are washed and brushed with warm water and soap; the hands must possess a special cleanliness, and both they and the instruments must be washed with disinfectant solutions, such as carbolic acid, permanganate of potassium, boric acid, salicylic acid, or others. Instruments must be washed with water and alcohol, and kept submerged in antiseptic solutions. Nickel-plated instruments should be given the preference over others.

The accoucheur must sedulously avoid all contact with other patients, especially those suffering with contagious or organic diseases (eruptive fevers, cancer). The nurses should be chosen from among those who attend only lying-in women, and be attentively watched with reference to their cleanliness and their regular habits.

Physicians in charge of hospital service must take still stricter precautions than others. Indeed, the sanitary condition of maternity institutions is rarely absolutely perfect, and therefore, since such physicians are more exposed than others to contact with sick women, they must be still more scrupulous and painstaking. We absolutely prohibit visiting a parturient, and more particularly a lying-in woman, after leaving a hospital, especially if the physician has been obliged to perform or even assist at an autopsy. But there is one condition under which the physician must absolutely abstain from attending a woman in labor, and that is, when he has been called upon to examine patients with fœtid lochia (puerperal infections, retained placenta, etc.). In fact, in such cases, no matter what attention the physician bestows upon his hands, they retain for twenty-four, and even forty-eight hours, a special odor, which clearly proves that organic particles, morbid germs, still adhere, and we believe that in such cases the physician must substitute in his stead an experienced confrère, so as to avoid grave consequences. Although this can be done in cities, it is otherwise in country practice. In the latter case, the physician must make free use of antiseptic solutions, and avoid examinations unless their necessity is absolute.

The physician who is called to attend a case of labor must always have with him, especially in the country, a certain number of drugs and instruments, the necessity for which may arise at any moment. The obstetrical bag must always contain a pair of forceps, a complete catheter (male and female), a laryngeal tube, a stethoscope, linen or flannel bandages one and a quarter inches in width, chloroform, laudanum, and ergot. Since ergot in substance may undergo change and lose all activity when long powdered, we much prefer solutions of ergotin, among which that prepared by Yvon seems to us infinitely superior to all the others. Its strength is such that a cubic centimetre of the solution represents exactly one gram of ergot of rye (or one minim equals one grain). Again, should the solution be intended for subcutaneous injection by means of Colin's syringe, which holds exactly one cubic centimetre (15 ♏) of distilled water, the dose given will be known. Ergot, when injected under the skin, acts after one and a half to two and a half minutes, while by the mouth it requires from six to ten minutes to manifest its activity; moreover, the solution (by injection) causes neither vomiting nor consecutive abscesses. For these reasons we prefer subcutaneous injections to all other modes of administration of the drug, and during the three years that we have employed them we have had only good effects. Arrived at the bedside, the obstetrician must assure himself that everything is in readiness for the baby: thread for ligating the cord, small compresses and bands to hold the funis in place, warm water for the bath, clothing for the infant, etc.

The obstetrician must first ascertain the hour when the contractions commenced, their character, assure himself of the facts by remaining near the patient, and not until some time has elapsed should he proceed to internal examination, which will give him definite information as to the degree of dilatation, the integrity or rupture of the bag of waters, the presentation, position, the conformation of the pelvis. We have said above that the accoucheur should assure himself of the latter points during the last months of pregnancy. At this time it is important for him to ascertain that the woman is really in labor, and how far it has progressed. The fact of labor being established, the accoucheur has the woman placed in the largest, best aired and lighted room of her dwelling, the temperature of which should be moderate, 50° to 61° F. He should clear the room of all persons who are not indispensable, or whose presence is not demanded by the patient. It is best for the patient, and, we may say, for the accoucheur, if the parturient be alone with him and the nurse, but it is impossible to lay down absolute rules. The obstetrician must divine, comprehend, who are the persons by whom the patient desires to be surrounded; he must demand, if need be on the strength of his authority, that the husband, the mother, mother-in-law, sisters, leave the room if the patient desire it; therein lies an extremely delicate point of practice on which we need not lay stress.

The patient must be dressed loosely; in the beginning, a wrapper or skirt suffices. Later, before the patient takes to the bed, the chemise suffices, but it should be raised as much as possible behind, to prevent its being soiled by the blood and liquor amnii which will escape. It is the rule to give an enema at the onset of labor, so as to clear the intestine. This will save the patient the annoyance of being soiled with fæcal matters at the end of labor, an accident which fills her with repugnance, and may so worry her, in certain cases, that the attendant is obliged to tell her not to mind this annoyance, which, with certain women, is so great that they restrain the necessary expulsive efforts. But in spite of all these precautions, women often feel the necessity, especially toward the end, of using the commode. It is advisable not to permit them to do so; on the one hand, because the sensation is generally illusory, and due to the pressure of the head on the rectum; on the other hand, especially in multiparæ, because this sensation often indicates the presence of the head at the external orifice of the genital passages. The patient should be told, therefore, to avail herself of the bed-pan or basin instead, but should never be permitted to go far from the spot where she is to be confined. The state of the bladder must likewise be carefully watched, for, although a considerable number of women urinate frequently, there are others in whom the pressure exerted by the head on the bladder causes an actual retention of urine, which requires to be relieved by the use of the catheter. If the female catheter fails, as it frequently does, we must try either a male metal catheter or one of soft rubber. On elevating the head a little, we usually succeed in overcoming this difficulty, at least when the head is not too far engaged. Indeed, retention of urine is not without effect on the uterine contractions, not to mention graver accidents which may supervene.

It is not necessary to make the woman lie down at the onset of labor, but here again the wish of the patient should be respected. In some cases in particular, if the dorsal decubitus be assumed too early by the patient, it seems to induce a diminution in the frequency of the pains. In that event, it will be advisable to make the woman rise and walk about a little, but not to the extent of fatiguing her, for, as we shall see, there are other preferable means of regulating and stimulating the pains.

Should women be confined in their own bed, or is it better to substitute another one (a lying-in couch, an iron bedstead, etc)? For our part, we much prefer to deliver the woman on a separate bed, and transport her subsequently to her own, except in cases where the woman is very tall, very stout, very fat, or where it is impossible on account of peculiarities of the dwelling.

Thereby we have the advantage of being able to place the patient in a fresh, clean, white bed (we proscribe the use of a warming pan, a bottle of hot water suffices), one which has not been soiled during the efforts of the woman, and the feeling of comfort it gives rise to in the patient compensates largely for the inconvenience caused by transporting her from one bed to another, after her delivery. If the chemise is not stained we do not change it, but if it is soiled in the least, a clean one must be substituted. It is the accoucheur's duty to make this change with all due precautions and with a view to the convenience of the patient, and, as a matter of course, the toilet must be made most carefully after delivery. (*Vide* "Care of the Woman after Delivery.")

The lying-in couch should be high rather than low; it should be protected with wax cloth or a sheet of rubber cloth, and made like an ordinary bed; one or two mattresses, two sheets, and one or two blankets, according to the season. One pillow, with bolster, generally suffices; the under sheet is covered with one or two draw-sheets, to be changed if necessary. The Alsatians are in the habit of placing upon the mattress a large sac filled with bran, which absorbs the liquids and thus saves the woman contact with fluids escaping from the genitals.

This is the most common method, where the women are delivered reclining on a bed. But in Germany and Holland, obstetrical chairs, so called, are also often made use of. Schroeder has reproduced from Rösslein (1528) a cut of one of his obstetrical chairs, and of the position of the woman while being examined by the midwife.

Position of the Woman.

As to the position the woman ought to occupy on the bed, there is no absolute rule; usage varies in different countries. Thus, while in France the dorsal decubitus is customary, in England and America women are delivered on the side, generally the left, the buttocks at the edge of the bed, limbs and thighs flexed, and the knees separated by pillows. In certain cases, this position presents incontestable advantages, besides permitting a more thorough supervision of the perineum. Moreover, certain authors advise, not only the lateral decubitus, but even a crouching position, or the knee-elbow position; but the latter in particular should be reserved for quite exceptional cases. But whatever be the position of the woman, the bed should be neither too high nor too low, and must offer a sufficiently resistant surface not to be too far depressed by the buttocks of the patient. In some cases it is advisable to slide between the two mattresses a board or a leaf from a table which will prevent excessive sinking in of the bed.

During the whole duration of labor, the woman should take only liquid nourishment, soups, bouillon, etc.; for we have frequently observed vomiting; of beverages, syrups and teas may be permitted. We prefer grog, weak tea, and coffee largely diluted with water.

Whenever the accoucheur has to make an internal examination, he must first anoint his fingers with some greasy substance, cerate, cold cream, sweet oil, or oil of sweet almonds. We commonly employ carbolated oil or carbolated vaseline. It is self-evident that the hands must be carefully washed after each examination.

Another question is, Should the accoucheur remain constantly near his patient? No absolute rule can be laid down in this respect; the physician must be exclusively governed by the wish of his patient with reference thereto: but in a general way we may say that in primiparæ the presence of the accoucheur is really of little use until after the membranes have ruptured, and when the cervix has dilated to the diameter of a silver dollar. In multiparæ it is not prudent to wait so long; at all events, if the physician leaves, he must return to his patient at least every two hours; but if the diagnosis is not yet complete, or the presentation is not regular, he must not leave his patient on any pretext.

When expulsive pains commence, the physician must approach the bed of his patient, on the right side if possible, so as to supervise the descent of the head from time to time, and support the perineum at the time of its disengagement.

While the dilatation is still incomplete, the woman may lie down, sit up, or walk about. But as soon as the dilatation is complete, whether the bag of waters be intact or broken (we shall see later that it is sometimes advisable to rupture it), the woman, especially if a multipara, must be absolutely recumbent, unless a retardation of the labor be noticed, in which case it will be advisable to let the patient walk about until the pains become regular and pronounced.

Back pains and cramps are to be combated by frictions and massage, often, it is true, without much success.

Ordinarily, the membranes rupture spontaneously, but in some cases they preserve their integrity too long, and their resistance alone suffices to retard the labor, by interfering with the regularity of the contractions. When the bag of waters is very tense in the vagina, it can be easily ruptured by pushing the finger against it during a contraction; but if the membranes are flaccid or if the bag of waters is small and flat, we may sometimes meet with some difficulty. In the former case, it is generally sufficient to carry the finger farther back and upward, where a greater accumulation of liquid is generally encountered, with greater tension, and where pressure with the finger nail against the prominent point will effect the rupture. When the bag of waters is flat, pressure with the finger will fail; then the membranes must be scraped, as it were with the nail, so as to break them by erosion. If these measures fail, a lead pencil, a tooth-pick, a quill cut to a point, guided by two fingers introduced up to the membranes, will perforate them and cause the liquor amnii to escape. Depaul, in such cases, trims the nail of his index finger to a slight point and breaks the membranes by a to and fro movement.

We have seen above that in primiparæ the anterior lip of the cervix often becomes caught between the head and the symphysis, causes violent pains and interferes with the engagement of the head. We must beware, in this case, of pressing on the cervix and endeavoring to increase the dilatation. This will only produce one result—it will aggravate the pains, and chafe and bruise the cervix. It is best, during a contraction, to pass the finger between this anterior lip and the presenting part, to support the lip in this manner, and crowd it back a little so as to permit the fœtal part to descend and the lip to rise. [We believe it preferable, as well as less risky to the integrity of the cervix, to push the lip above the head during the interval, and hold it there during the pain.—Ed]. The head often descends rapidly in consequence of this little manipulation.

When the head has arrived at the perineum, we must beware of introducing the fingers into the inferior portion of the vagina, and of pressing upon the pelvic floor, upon the coccyx. Not only is it useless, but it is badly borne by the patients. It is best to lubricate the parts with a little sweet oil or cold cream, and to watch the distending perineum which the head, about to emerge, is approaching.

RUPTURE OF THE PERINEUM.—MEANS OF AVOIDING IT.

It is important that the perineum should suffer no laceration. Formerly, it was advised to support the perineum directly by putting the hand upon it, the thumb on one side of the vulva, the other fingers on the other side, the posterior commissure of the vulva being thus in contact with the edge of the hand, the thumb separated from the fingers. (Figs. 239 and 240). Aside from the inconvenience of being thus deprived of the view of the perineum, this procedure often fails, and the laceration occurs under the hand pressing on the perineum, without its being able to prevent it. Depaul gives another procedure which appears to us far preferable, and which consists in leaving the perineum uncovered, and in opposing the too rapid progress of the head. When the head has arrived at the vulva, he places two fingers of the left hand on that portion of the head which corresponds to the anterior commissure of the vulva, and two fingers of the right hand on that portion which touches the inferior commissure, and thus counterbalances the effect of the uterine contraction.

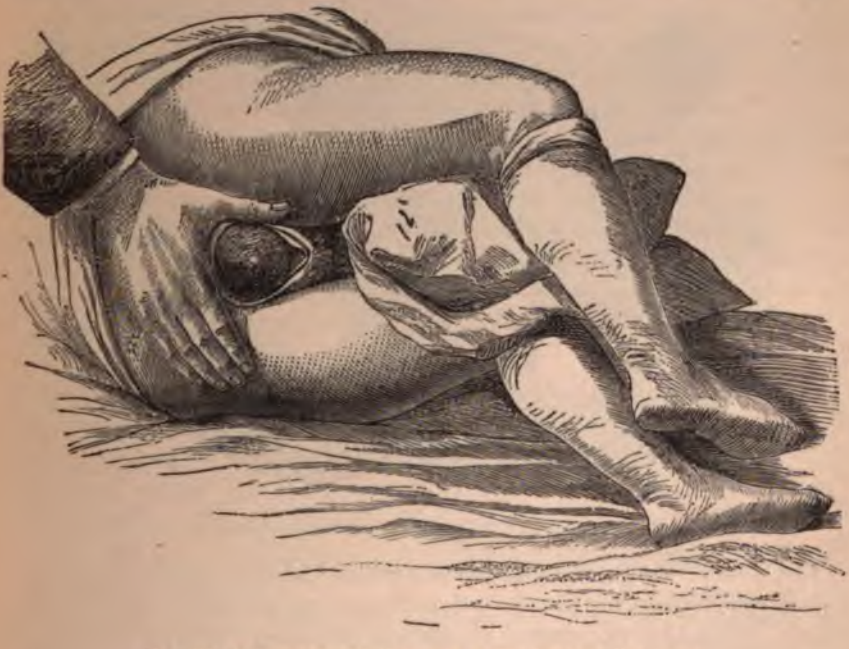

FIG. 238. -SUPPORT OF THE PERINEUM IN THE LATERAL DECUBITUS.

The vulva can thus dilate gradually, the head is gently directed higher against the pubes, which aids the movement of deflexion, and in this way the strain on the posterior commissure is diminished.

Sometimes, however, the distension of the perineum is such that rupture threatens in spite of these precautions. In that event, episiotomy may be performed; small incisions are made into the vulva, so as to relieve the tension and thus prevent a laceration which we cannot always control. Authorities are not in accord as to the point where these incisions ought to be made. The great majority of obstetricians make them into the latero-inferior portions of the vulva, that is to say, obliquely, in the direction of the tuberosities of the ischium (a single incision generally suffices).

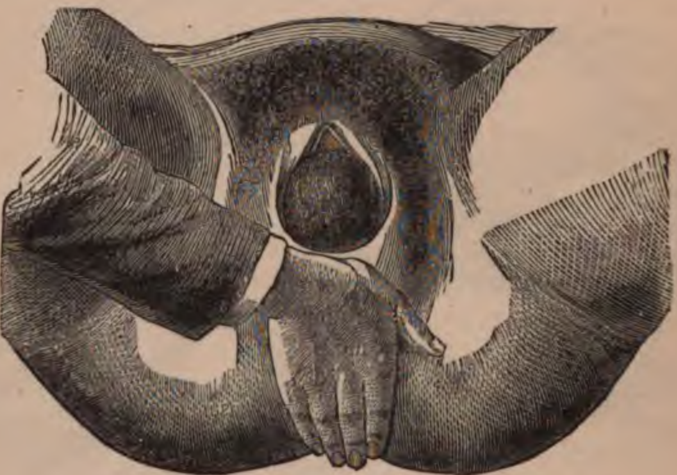

FIG. 240.—SUPPORT OF THE PERINEUM IN THE DORSAL DECUBITUS.

Tarnier and Budin have demonstrated, on the one hand, that these lateral incisions do not always prevent a median laceration, and on the other hand, that these perineal lacerations invariably started at the vaginal orifice, at the mucosa, the skin parting subsequently. Tarnier therefore advises to divide the vaginal orifice, first exactly in the median line, by an incision with scissors which encompasses both the vaginal and the vulvar orifice; then, when the incision has reached an extent of one-fourth to one-half inch at the most, to incline the scissors either to the right or left, so as to make the incision, which commenced perpendicularly, terminate laterally; this possesses the advantages of the lateral incision, and prevents the longitudinal rupture from passing certain limits should it tend to occur.

Again, different perinea vary in their power of resistance toward rupture. Those which are thin and supple most frequently remain intact; those which are large and thick, almost œdematous, are the ones which generally rupture.

After the head has emerged, the disengagement of the shoulders must be supervised, for it is not rare to see a perineum, which the head has left intact, give way during the delivery of the posterior shoulder. It is best to aid the passage of the trunk by elevating it toward the symphysis pubis, so as to make the posterior shoulder glide over the perineum, and then to guide it outside the vulvar orifice.

The accoucheur must never forget to watch the condition of the fœtus attentively by the aid of the stethoscope, and when its condition or that of the mother requires intervention, to proceed with it at once by putting the woman in the obstetrical position, across the bed near its edge, the buttocks close to the edge, the feet resting on two chairs.

It is hardly necessary to mention that the accoucheur must have at hand a certain number of napkins, which are taken away as they become soiled.

Ergot.—Ergot must never be employed during labor; it does not find application until later, and we consider the law formulated by Pajot as absolute:

"When there is anything in the uterus, be it an infant about to be delivered or clots, never use ergot until the uterus is completely emptied."

Such are the general rules which must guide the accoucheur with reference to the care to be given to the mother.

Care of the Infant.

Watch the fœtal heart-beats carefully. So long as they are distinct and undisturbed, abstain from any intervention; but proceed at once to terminate the labor by manual or instrumental means, as soon as danger threatens; provided, however, that the dilatation of the cervix permits the extraction without endangering the mother.

We will see, in connection with the several presentations, when this intervention is called for.

We have laid it down as a principle, that we must assure ourselves toward the end of pregnancy that the presentation is regular, normal (breech or vertex), with a view to correct it before labor by external manipulations; but if not called in a case of faulty presentation until the beginning of labor, version must nevertheless be attempted by external, or if need be by combined manipulations (bi-polar version of Braxton Hicks), so as to change the presentation. It is true that we often fail, but we shall be on our guard, and be prepared to interfere at the time we have chosen.

SPECIAL PROVISIONS REQUIRED BY EACH PRESENTATION.

Vertex Presentation.

Since the vertex presentation is the most favorable, it will require the least special care. Ordinarily, the accoucheur's part is passive; he confines himself to encouraging the patient, to advising resignation and patience, and explaining that he not only cannot, but must not interfere—that it is Nature who will accomplish her task, and that intervention must be reserved for cases of absolute necessity. Still there are certain indications to be met, especially in primiparæ, and some cases in which the accoucheur can be really useful. Without wishing to anticipate here what will be considered in the chapter on the employment of anæsthetics in normal labor, we may say that there are certain primiparæ who are so nervous, on whom the pains make such an impression, that their excitement rises to utter indocility, and if not allayed, the labor is retarded or arrested and the patient put into an unsatisfactory condition. It therefore becomes absolutely necessary to calm this excitement, and of the drugs which have answered best in our hands in these cases chloral stands foremost. It is especially in the stage of dilatation, when the cervix is hard, tense, and somewhat rigid, that this excitement occurs, and we resort to chloral, either in solution in syrup, or, preferably, by enema. Sixty grains of chloral in three fluid ounces of quince mucilage, introduced by means of a syringe and not by the irrigator, repeated if necessary after five or six hours, will frequently calm this extreme agitation, and secure to the patients relative rest, of which they are in great need. Not that we reject in these cases the applications of belladonna ointment or extract to the cervix, which Dubois advises, but the action of chloral seems to us far superior.

In a certain number of primiparæ the first stage drags for an indefinite time, owing to the slowness with which the cervix dilates. The slowness is not due, as in the before-mentioned cases, to rigidity of the cervix, which is soft, but the pains are slow, feeble, and irregular. The cervix attains a dilatation of about half a dollar and remains at this point without progressing. The membranes bulge slightly, and there is nothing to explain the slowness of labor but the feebleness of the uterine contractions. It is in these cases that certain accoucheurs employ ergot, which we absolutely prohibit. There is in our opinion a far more certain measure, and that is rupture of the membranes. However, this must not be done at haphazard; certain conditions only authorize this intervention. It is necessary, first, that the presentation be good (vertex); second, that the fœtal heart-beats be regular, normal—in one word, that the child do not suffer; third, that the conformation of the pelvis be good; fourth, that the labor be in progress relatively long, that the cervix be normal, and that its dilatation be at least equal to the diameter of a silver half dollar. In such cases, we have often observed that the rupture of the membranes was followed by an acceleration and a relatively rapid termination of the labor. In certain cases, rupture of the membranes alone does not suffice, and the fœtal head must be slightly elevated so as to evacuate some of the liquor amnii. The latter manipulation should always be practised in the interval of contractions. [Instead of premature rupture of the membranes, we should be tempted to try a mild faradic current, one electrode over the abdomen, the other over the back, or held in the patient's hand. If the current be mild, and not passed directly through the fœtal poles, it can do no harm, and will intensify and regulate the pains.—Ed.]

If the presentation is oblique or irregular, beware of rupturing the membranes before the presentation and engagement have become regulated.

It is not rare, in posterior positions, for rotation to be delayed, or even fail to occur, and some obstetricians advise to bring the occiput forward. Velpeau advises, when the head has descended into the excavation, and almost immediately after the rupture of the membranes, to make it deviate to the right or left, in the intervals of the contractions, by sliding two or three fingers either in front of the sacrum to push the occiput forward, or behind the pubes on the sides of the forehead so as to carry it backward. Tarnier advises to take hold of the head with two fingers placed behind the ear, and thus to act upon the head so as to bring the occiput forward. We believe, with Cazeaux, that these manipulations are absolutely useless. Either the rotation tends to take place, and then it will occur spontaneously; or it fails to occur; or else, it is effected in the posterior direction, the occiput returning into the concavity of the sacrum. In that event, although we may work upon the head, rotation will not occur, and the forceps alone, and not even invariably, can effect this rotation; hence we much prefer to abstain.

Once rotation effected, the only obstacle the head can encounter is the descent of the anterior lip of the cervix, which we have explained above. As to the perineum, we have likewise indicated what is to be done. It sometimes happens, as Jacquemier has pointed out, that the shoulders fail to turn, and thus oppose an obstacle to the passage of the trunk; this constitutes a veritable form of dystocia which we shall consider hereafter.

Face Presentation.

Face presentations have long been considered as so grave by most writers as not to permit the normal termination of labor; they hold that every effort should be made to change them into vertex presentations, and where this fails, to resort to version. Portal, indeed, recommended to leave the case to Nature; but Dionis, Smellie, Viardel, de la Motte, Baudelocque, and Capuron still advise early intervention, and only when we come to Mme. Lachapelle do we find the principle laid down that delivery by the face is *at least* as easy as delivery by the vertex. Without admitting this proposition of Mme. Lachapelle, which in this form is too absolute, all modern obstetricians, headed by Depaul, at least in France, have advised to remain inactive, unless absolutely forced to interfere.

Schroeder, and other German writers, strictly discriminate between presentations of the face and those of the brow, and their procedures vary accordingly. Still, some among them have returned to early intervention, and seek to transform the face into a vertex presentation, by internal, external, or combined manipulations.

Pippingsköld advises to change the face into a vertex presentation. In one case, after vainly trying the forceps and lever, he succeeded by pressing one hand on the chin, then on the alveolar border of the superior maxilla, and lastly on the borders of the orbits, while the other hand exerted counter-pressure on the occiput through the external abdominal walls. He was thus able to flex the head, and the application of the forceps at once terminated the delivery.

This transformation of the face into a vertex presentation has been accepted by Osiander, Rösshirt, E. Martin, Hildebrandt, Fasbender in Germany, and by Baudelocque in France, but rejected by Mme. Lachapelle, Chailly, Dubois, Depaul, and Cazeaux.

Schatz resorts to external manipulations. According to him, it was solely at the beginning of labor, and exceptionally at the end of pregnancy, that he had occasion to attempt a change of the presentation; he assails the transformation by internal manipulations as practised by Fritsch and Baudelocque, and that by combined manipulations performed by Pippingsköld, and, after indulging in a series of geometrical and mechanical demonstrations in which it is very difficult to follow him, he proposes this procedure:

He does not touch the head directly, all the more because he advises intervention after the onset of labor, and the rupture of the membranes, and because the head, consequently, can only be grasped incompletely. Instead of acting on the head, he seeks to grasp that part of the back which is nearest the head—that is to say, the shoulders and the top of the thorax (through the abdominal walls)—and, in the interval between two contractions, he crowds them first upward, and from the side where the back of the fœtus lies. As soon as the shoulders and the chest have been thus brought into the vertical axis, they are no longer pushed upward, but toward the back of the fœtus. In this movement, and by this pressure, not only the shoulders and chest of the fœtus, but the uterus likewise, are twisted to one side (the right, for instance); therefore the other hand should fix and hold in place the fundus uteri and the breech of the fœtus, or at least push them back from the opposite side; that is, from the side where the thorax lies. The shoulders and chest are thus brought into the vertical axis, but led away from the left side; in short, while the trunk is given an impulse from one side, it is drawn away from the other side through action on the podalic extremity of the fœtus. If, notwithstanding, the head does not leave the border of the superior strait, it is forced to do so by exerting with the hand pressure on the corresponding side of the pelvis, or by having an assistant do so. In this way the movement the head is to go through is completed.

According to him, the advantages of this method may be summarized in the following propositions:

1. The manipulation is harmless for both mother and infant. The only thing to be feared is, that the face presentation may be transformed into a brow presentation; but the latter will soon again change into a face presentation.

2. The manipulation is practicable as soon as the face presentation is recognized, during pregnancy as well as at the beginning of labor, until the end of the first stage of dilatation (Schatz believes it to be possible even later, when the bag of waters is intact). It will succeed more readily in proportion as it is practised earlier, but must be rejected when the face is engaged too far, and when the shoulders have passed the cervix.

3. This method requires no other precaution. If the membranes remain intact and the operation fails, the former condition will be reproduced; if it succeeds, the prognosis becomes favorable.

4. If this manipulation succeeds with the face, it will be all the more likely to do so in brow presentations.

Welponer has employed Schatz's procedure in one case with success; but, after having seen the occiput come down and descend, and this so forcibly as to rupture the membranes, he found the face presentation reproduced, with the only difference that the face, at first in the first position, was in the second position after the manipulation. The child was born living; the pelvis was generally contracted, and the conjugate diameter measured three and three-quarter inches.

For our part, we do not see any objection to trying Schatz's procedure, but we advise not waiting till the beginning of labor. We would act toward the end of pregnancy, but this presupposes the existence of a primary face presentation recognized before the beginning of labor, and such are rare. Secondary presentations are the rule, and it is mainly during labor, when far enough advanced, that they are recognized. We believe, therefore, although this method may be tried without danger, it will often fail.

Schroeder, and other German writers, strictly discriminate between face and brow presentations. In the former, Schroeder says, when the face is completely engaged in the pelvis, we should wait as long as we can, and then resort to the forceps. If rotation is delayed, we might attempt first to lower the chin, then to inaugurate this rotation by exerting pressure on the forehead in a contrary direction. But when the face is not engaged, and the chin posterior, version is to be resorted to, and when this is no longer practicable, Pippingsköld's procedure should be tried, so as to transform the face into a vertex presentation.

If, on the other hand, we have to deal with a brow presentation, version should be practised if the orifice is sufficiently dilated and the brow still movable. If version is no longer possible, we must try to transform the brow presentation into a vertex or face presentation, by Hildebrandt's method. The latter consists in pressure exerted, during a contraction, on the forehead, either in the direction of the face or in that of the vertex. Playfair demonstrates that Hodge's procedure is nothing else but that of Baudelocque, but that it admits of attempts at transformation only in cases where the face remains above the superior strait and fails to descend into the excavation. On the whole, he prefers podalic version to all the other procedures. When the labor does not terminate, there is either uterine inertia or absence of rotation; then the forceps must be resorted to.

Penrose attempts to cause rotation by the aid of the hand or the blade of the forceps; he claims to have succeeded several times.

As Playfair observes, rotation is often retarded until the face has reached the inferior portion of the excavation. Hence we must not interfere too soon.

What causes the real difficulty in face presentations is the absence of the movement of rotation, and, although we accept version by external manipulations at the end of pregnancy or the onset of labor, we carefully abstain from any manipulation as soon as the face engages and labor seems to progress. Then, in fact, Schatz's opinion to the contrary, version by external manipulations is impossible, and attempts to transform the face into a vertex presentation by internal manipulations seem to us injurious rather than useful. Delivery by the face must always and does take a longer time than delivery by the vertex; but we should not hasten to interfere, and must know how to wait. Only when we have become thoroughly convinced that rotation will not take place, or when it is in the interest of the mother or infant, should we interfere. Our preference is for the forceps. Unfortunately, as we will see, the application of the forceps in face presentations does not always give the result we hope for. Artificial rotation of the chin does not succeed, and we are then forced to resort to embryotomy. We ourselves have had occasion to interfere eight times in face presentations in M.I.R.P. or M.I.L.P. with or without complications (procidentia of members or cord), in city and hospital practice (we have never assisted at the beginning of labor, and have only been called as a last resort). Once only have we succeeded in bringing the chin forward and delivering a living child (female); six times we have been obliged to resort to the cephalotribe. In one case (face, unsuccessful attempts at version, prolapse of one foot, one hand, and funis), we were forced to extract the fœtus piecemeal, the forceps and cephalotribe having successively failed.

In our opinion, therefore, once the labor has commenced, we must wait, watch the fœtal heart-beats with greater attention than ever, and, when the fœtus is in danger, apply the forceps as soon as the dilatation permits, performing first artificial rotation of the chin, then extraction.

Even in cases where rotation takes place spontaneously, labor is sometimes prolonged, owing to exhaustion of the uterus and inefficiency of the contractions. Here again intervention should be subordinated to the condition of the fœtus and the mother; but it must not be forgotten that excessive prolongation of the labor may have grave consequences for the mother. Hence we dare not wait too long before interfering, and although we advise, as a general rule, to await rotation, we do not hesitate to terminate the labor by the application of the forceps when rotation has taken place, and the contractions become less frequent.

With reference to brow presentations, we are far from sharing the opinion of German authors as to their exceptional gravity. In harmony with French obstetricians, we look upon them as presentations intermediate between face and vertex presentations.

If we are wise enough to wait, we will always see them spontaneously transformed either into vertex presentations, which is by far the most fortunate circumstance, but it must be admitted rather rare; or else, into frank and regular face presentations. Then the accoucheur finds himself again in the ordinary conditions for intervention in face presentations.

Breech Presentations.

Although breech presentations are not absolutely serious for the mother, they must nevertheless, as we have seen, render the prognosis more reserved, since the mortality rises to one per cent., while it is only 0.57 per cent. in vertex presentations. For the child, however, the danger is much greater, since the mean mortality is 35 per cent. during labor and delivery. Five per cent. of the children born alive succumb within twenty-four hours of their birth, while only two per cent. die during labor in vertex presentations, and but one per cent. of the children perish in the first twenty-four hours. It would seem, therefore, that the idea of transforming breech into vertex presentations should have occurred to obstetricians long ago but this was not the case for two reasons: first, version by external manipulations was not known; second, when this form of version was known, it was considered dangerous and impossible in these cases.

Mattei was the first who clearly formulated the idea of this transformation of breech into vertex presentation, who laid down the indications for it, and described the operative procedure. Although Goubelly had tried it first, and without success; although Wigand and Flamant had laid special stress on version by external manipulations, these proposals were rejected by Scanzoni and E. Martin, and accepted with a reserve bordering on repulsion by Dubois, Desormeaux, Chailly, and Devilliers. It was Mattei who first demonstrated that this operation, if it was to succeed, should be practised, not as formerly during labor, but at the end of pregnancy and before the onset of labor. But this applied chiefly to version by external manipulations in cases of transverse presentation. As regards breech presentations, Jacquemier accepted version with hesitation, Petrequin of Lyons declared decidedly in its favor, while Herrgott rejected it before labor, and it is only when we come to the time of Hubert of Louvain and of Nivert that we see version by external manipulation applied to the transformation of breech into vertex presentations. Since then, Tarnier and his pupils, Pinard, Chantreuil, and Budin, have readopted the proposal, and in Germany, Hegar considers it perfectly justifiable.

For our part, without absolutely rejecting the artificial transformation of breech into vertex presentations, we accept it only with great reserve, for the following reasons:

1st. Although the prognosis of breech presentations is serious, this is the case mainly in primiparæ, and not in multiparæ. It would seem, therefore, that the partisans of this operation should practise it chiefly in case of primiparæ. Yet Pinard himself, in the chapter on contra-indications, particularly insists on primiparity, "and when the presentation is the result of an accommodation, when the presentation is always the same about the end of pregnancy, when, in one word, the variety exists which is termed frank, the evolution may be impossible. We must then desist after a few attempts, which may be repeated after some hours, or after some days, but which must always be practised with the greatest gentleness and very slowly." Hence it is really in cases where version by external manipulations could be of use that its most confirmed adherents renounce it, because it fails, and this before labor. What if it were to be attempted during labor?

In multiparæ, version appears to us useless. The laxity of the soft parts, the lesser resistance of the cervix and the external parts, permit of an easy disengagement of the pelvic extremity, and we ourselves have always delivered living children in multiparæ. The mothers never suffered from any accidents.

2d. The prognosis is not alike in all presentations. Presentation of the buttocks is the gravest of all. In such cases, therefore, we could, and by rights should, practise version by external manipulations, but this presupposes that the diagnosis be made before the onset of labor; yet this is next to impossible. The pelvic extremity is readily recognized, but neither palpation nor auscultation nor the touch enables us to make the diagnosis of the variety of the presentation before labor. Yet during labor this version is impossible, and hence it is useless to attempt it.

3d. In our opinion, the dangers for mother and infant depend perhaps less on the presentation as such, than on the inexperience and the meddlesome intervention of the obstetrician. In fact we believe that, in a fair proportion of cases, intervention is useless and can only have bad effects;

and on the other hand, when this intervention is necessary, there is, as it were, a moment of election which we must take advantage of, in order to arrive at a satisfactory result.

Three instances may be encountered. The child may present: 1, by the complete pelvic extremity (buttocks and feet); 2, by the incomplete pelvic extremity; 3, by the buttocks, the members extended over the anterior plane.

1. *Buttocks and Feet.*—This is the simplest of all; the entire first portion of labor proceeds regularly, and it is only when the breech is about to be delivered that dangers arise for the child

Since intervention may nevertheless become necessary at a given moment, the accoucheur must have in readiness whatever may be indispensable, warm water for the child's bath, vinegar, laryngeal tube, forceps, and cord; he must attentively watch the fœtal heart-beats, and from the moment when the breech appears at the vulva, or better still, from the moment that it has descended to the pelvic floor, have the patient placed in the operative obstetrical position, *i.e.*, across the bed, the buttocks at the edge of the bed, the feet resting on two chairs, the limbs held by two assistants. The accoucheur then places himself on a low chair, facing his patient, and holds himself in readiness to supervise the evolution without leaving the patient for a single instant. If everything proceeds normally, the breech with the feet, is disengaged slowly from the vulva, then the hips appear, and at last the funis. It is only necessary to take the cord between the fingers to assure one's self of the integrity of its beats, and hence of the life of the fœtus. If the funis seems strained at the level of the umbilicus, it is eased by bringing forward a portion of its length. Then the fœtal extremity needs only to be sustained without exercising the least traction, and the rotation movement, which the trunk performs in its disengagement, favored. While the accoucheur sustains the fœtal extremity, one of the assistants rubs the fundus uteri during its contraction so as to re-enforce the latter. We then see, even without any friction if the contractions are vigorous, the trunk and the arms appear, the latter remaining applied to the trunk; and finally the head is disengaged in its turn. Nothing remains but to tie and cut the cord.

Depaul is in the habit, if the contractions are not vigorous, of administering to the woman, at the moment when the breech appears at the vulva, thirty grains of ergot in three doses given at ten minutes' intervals. We believe that this practice, although harmless in the hands of our experienced professor, may become dangerous if generally resorted to, and we uphold Pajot's law—never to give ergot unless the uterus is empty.

We much prefer frictions over the fundus uteri, and, if necessary, direct pressure exercised upon the head through the abdominal walls. We prohibit traction which, if the contractions are at all feeble and far apart, can lead to but one result, extension of the arms, possibly extension of the head, arrest of the rotation movement of the head, and will thus become a cause of disaster which would have been avoided if it had been left undone.

But if the disengagement takes place too slowly, if the uterine contractions are not vigorous enough to effect the disengagement, if the arms are elevated, if the head is extended or fails to turn, we must interfere, and this resolutely.

If the contractions are merely slow and feeble, wait as long as the condition of the mother or of the child permits; then extract as rapidly as possible.

If the evolution progresses too slowly, intervention is likewise called for, but the precise time is difficult to determine. If traction be made too soon, before the trunk has emerged, while the contractions are feeble, the arms are very liable to be extended. If traction be too long delayed, the arms may have become spontaneously extended, and, since the trunk of the child is delivered, inspiratory efforts might be made which would jeopardize its life. In our opinion, the time for intervention is when two-thirds of the trunk are delivered—in other words, when the greater part of the thorax is outside, and the trunk achieves its movement of rotation.

If now we make vigorous traction from below upon the trunk, we engage the posterior shoulder as soon as possible. Then forcibly raising the trunk toward the symphysis, we disengage the posterior arm with the right hand; then lowering the trunk, we free the anterior arm in the same way, and terminate the extraction by forcibly raising the trunk toward the symphysis. This presupposes rotation completed, and flexion maintained. If flexion has not persisted, two fingers of the left hand are introduced into the mouth, the chin depressed, two fingers of the right hand applied to the occiput which is pushed up, and flexion thus effected, after which the head is rapidly disengaged.

If rotation has not taken place, the fingers introduced into the mouth effect at once both flexion and rotation, and this generally without difficulty. It is self-evident that this manœuvre must be quickly executed, and that traction must be exercised only during the pains, except in cases of absolute necessity.

If, on the other hand, the fœtal heart-beats indicate that the child is suffering, extraction must be effected as early and rapidly as possible. The feet furnish a good hold, and, without awaiting the evolution of the trunk, the fœtus must be extracted. The life of the fœtus here depends to a great extent on the skill of the operator. But then the conditions are no longer normal, and the state of the cervix, the dimensions of the pelvis, the intensity of the contractions, the volume of the fœtus, and particularly primiparity or multiparity, are so many circumstances which may have a more or less serious influence on the results of the operation.

II. *Feet.*—The conduct must be the same as in the preceding cases. Delivery is generally more prolonged, and hence the dangers run by the fœtus are more numerous. Intervention is, therefore, more frequently indicated.

III. *Breech Presentation, Members extended, Fœtus bent double.*—Here the difficulties are much greater. If we are obliged to interfere, we have not got the hold the feet afforded in the preceding case, and on the other hand, in these cases in particular, labor is prolonged, and the engagement and disengagement of the buttocks do not occur or do so very slowly. The fœtus suffers, the mother tires herself out, and we must interfere.

We cannot search for the feet of the fœtus because they are too far away, and even if they were within reach, they could not be brought to the vulva without fracturing the leg or thigh. Hence we must work upon the hips of the fœtus. It has been advised: first, to introduce into the inguinal fold a bent finger and bring down the breech, a measure which is good in theory, but usually fails in practice; second, to pass into the inguinal fold a blunt hook, the extremity of which is turned outward; but in the two cases in which we have seen it employed, by experienced men too, the thigh was fractured in one, and in the other the abdominal wall was lacerated above the inguinal fold.

[We disagree with the author in regard to the finger, whilst we would absolutely reject the blunt hook. The finger, if it can be passed into the groin—and if it cannot rarely can anything else—makes an efficient tractor, and, by grasping the wrist with the other hand, the breech may usually be brought down. The finger further is preferable to the fillet. It takes too long to introduce this, and in the cases referred to, the fœtus's life depends on quickness. Should the finger fail, the forceps applied over the trochanters, and carefully used, will often succeed, and this too without damage to the fœtus.—Ed.]

Playfair passes between the limbs of the fœtus, above the inguinal fold, a brass wire to which is attached a fillet of wool or linen which is intended to embrace the upper part of the limb. We believe that this must produce the same lesions as the hook. Hecker advocates the fillet; Gueniot advises to pull partly on the inguinal fold with fillet or hook, partly with the bent finger introduced into the anus, taking hold on the coccyx or the ischium, and thus to attempt to bring down the breech until able to act with the fingers of each hand on the inguinal folds.

Steidele and Gergues have invented double hooks forming pelvic tongs, which possess no superior advantage.

Now as to the forceps. Although rejected by Baudelocque, Flamant, Mme. Lachapelle, Schweighauser, Weidmann, and Stolz (who nevertheless has employed them), they have given unexpected results in the hands of Stolz himself, of Haake, Depaul, and Tarnier. We give them the preference. Although we must not forget that the forceps applied to the pelvic bones may expose the fœtus to some dangers, these are no greater than those inherent to the other procedures. If the fœtus be not extracted, it inevitably perishes, and therefore we are authorized to use an instrument which cannot of itself jeopardize the existence of the fœtus if prudently managed, and so applied that the blades grasp the breech in the bis-iliac diameter, while their extremities must not pass beyond the crests of the ilia.

Finally, there is another difficulty on which Depaul lays stress with good reason, that is, contraction of the cervix upon the neck of the fœtus. This is so grave a complication that the fœtus almost inevitably succumbs. Hence we must try, by introducing the fingers between the cervix and the fœtal neck, to overcome the obstacle and extract the head; but if the cervix be resistant, Depaul does not hesitate to incise it. It is hardly necessary to dwell on the fact that the difficulty of this manipulation complicates the prognosis for mother and fœtus.

When the head alone remains to be delivered, sometimes the hand, sometimes the forceps, must be resorted to.

Huter demonstrates that the extraction of the breech by means of the fingers introduced into the inguinal fold succeeds very rarely, and that the blunt hook is either useless or dangerous; that the fillet of Hecker and Playfair does not succeed any better, and that the pelvic tongs of Seidele and Gergues equally fail. He advises the forceps, which, however, should never be applied unless the breech is movable and still at the superior strait.

Kleinwächter gives preference to the fillet to bring down the breech, and applies the forceps only to the after-coming head.

Braun rejects the fillet, the blunt hook, and the forceps. If the child be living, we should restrict ourselves to manual interference.

Hegar combines the methods of extraction of Smellie and Braun.

Barnes rejects all instrumental intervention, and always searches for a foot, by means of which he extracts.

Kormann, after having fully shared Schroeder's opinion, and sided with him regarding the principle that, if manual extraction fails to deliver a living child, the forceps will not bring us any farther, has even gone so far as to say that the application of the forceps to the after-coming head is extremely dangerous to the mother, and has plainly advised perforation. He does so with certain reservations, for of thirty-one cases in which he was obliged to extract the after-coming head, he was constrained in four, after vain attempts at manual extraction, to resort to the forceps, and had living children in three, and only one dead child. He shows besides that, the application of the forceps to the after-coming head has a frequency of eleven per cent. of all cases, and that the indications for the forceps may be summarized under the three following heads:

1. Rigidity of the cervix and its contraction upon the neck of the fœtus

which exposes it to the danger of a laceration the extent of which cannot be determined.

2. Arrest of the chin above the symphysis, the occiput having descended into the posterior portion of the lesser pelvis.

3. Considerable disproportion between the head of the fœtus and the walls of the pelvis which exposes these parts to excessive compression. He lays down the following precepts which comprise his practice:

1. When the breech remains high up and the child is living, we must always search for the anterior foot, and by the aid of the latter bring down the breech. But if the child is dead, we must have recourse to the blunt hook.

2. When the breech is deeply engaged, we should always try to bring it down by means of the anterior foot. If the foot is beyond our reach, we must resort to the method of expression according to Kristeller, to the bent finger, or the fillet. The forceps should never be applied to the breech. If the child is dead, the blunt hook.

When the head alone remains and the child is living, the head should be extracted by the method of Veit, of Prague; if the cervix is rigid, the chin arrested in front, if the cranium is excessively compressed, the forceps. If the child is dead, perforation of the cranium.

However, whatever procedure be employed, the extraction of the fœtus in cases of pelvic presentations is far from being a simple matter. Besides the dangers threatening the fœtus from the presentation alone, the extraction is liable to cause lesions grave enough to jeopardize its life.

Lesions of the Fœtus produced during Extraction in Pelvic Presentations.

Following the lead of Pajot in 1853, the study of these lesions has been taken up anew of late years, particularly by Ruge and Ducourneau, both in 1876. While Scanzoni, Kiwisch, Lange, Spaeth, and Braun consider the extraction of the fœtus as an inoffensive operation in itself, Wigand, Joerg, Hohl, Naegelé, Martin, Ahlfeld, Schatz, Rokitansky, and Rubensohn show by personal observations, not only that the extraction entails dangers upon the fœtus, but that it is in itself liable to determine lesions grave enough to endanger its life.

Ruge, who has collected the majority of German observations reported until 1876, has found in 44 cases lesions following extraction, due to podalic version, and in 29 cases lesions following extraction in primary pelvic presentations, that is to say, 73 cases. He shows that certain of these lesions are frequent, and others rare, and he instances hemorrhages into the cervical region, into the muscles, into the cellular tissue surrounding the muscles, and, finally, true muscular lesions to the extent even of complete rupture of these muscles. The latter lesions may eventuate in suppuration or in cure, terminating finally in retraction of the sterno-cleido-mastoid—congenital torticollis. In sixty-four cases, he noted these lesions eighteen times. Finally, he mentions hemorrhages into the abdominal cavity—underneath the capsule of the liver and of the kidneys, —intra-cranial hemorrhages, tears of the sinuses, retro-pulmonary congestions, and fractures of the vertebral column.

After the above analysis, he compares the various methods of extraction, and pronounces himself in favor of that of Martin, and Kristeller, that is to say, he advises upward traction on the occiput, and depression of the face, assisted by careful compression. This is the method to which we usually resort. The forceps he rejects.

Transverse Presentations.—Here all authorities are in agreement. The diagnosis should be made during pregnancy, and the mal-presentation corrected by external version, transformed, in other words, into a presentation of the vertex. During labor recourse must be had to internal version, and, in the event of this failing, to embryotomy.

CHAPTER XIII.

LABOR IN CASE OF TWINS.

SPEAKING generally, labor in case of twins is a double labor. On the presentation of the fœtus will depend strictly the duty of the accoucheur. Whatever the presentation, however, external version is not possible as long as the twins are still within the uterine cavity. After the birth or the extraction of the first fœtus, if the second presents by the shoulder, external version may be resorted to, although podalic version is usually an easy matter, and a large number of authorities immediately resort to it. As a rule, we are frequently obliged to interfere in twin labors, and the following tables show the frequency of such interference, compared with that necessary in general labor.

Frequency of Interference in Labor.

Hugenberger, (1845-1849)	in	10	per cent.	of cases.
Veit and Winckel, (1856-1864)	“	22	“	“
Credé, (1856-1859)	“	13	“	“
Martin, (1860-1866)	“	15	“	“
C. Braun, (1867)	“	5.8	“	“
Dorhn, (1867)	“	11.7	“	“
At Dublin, (1847-1854)	“	3.2	“	“

Frequency of Interference in Twin Labors.

Reuss	in	14	per cent.	of cases.
Chiari, Braun, Spaeth	“	8	“	“
At Dublin	“	11	“	“
Siebold	“	59[1]	“	“
Mende	“	23	“	“

Reuss, from a study of 210 cases of twin labor, gives us the following statistics:

Spontaneous labor	161	or 76.7	per cent.
Assistance to one or both fœtuses	49	“ 23.3	“
“ “ first, the second without		9.	“
The first spontaneous, the second assisted		29.	“
Assistance to both fœtuses		11.	“

Ordinarily, after the birth of the first child, the pains cease for an interval which may vary from a few minutes to a few hours, or even days, and authorities differ as to the proper course to pursue, some being in favor of active intervention, and in this we agree, others being guided by the position of the fœtus, or the reappearance of uterine contractions.

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[1] During the time when Osiander was a pronounced partisan of intervention.

Kleinwächter favors the immediate extraction of the second fœtus by version, except where: 1st. The head or breech is engaged. 2. There is pronounced contraction, absolute or relative, of the pelvis, and the fœtal head is above the superior strait. 3. There exists a double chorion; one fœtus is born before term, and immediate extraction would result in birth before term of second fœtus.

Reuss is opposed to these views of Kleinwächter, and is guided in his action entirely by circumstances, under the same rules which govern natural labor. In 74 labors, he gives the following data as to the interval elapsing between the birth of the first and the second fœtus:

From 5 minutes to 1 hour	79 per cent.
" 1 hour to 6 hours	15 "
Over " "	6 "

Kleinwächter, on the other hand, gives the following figures for 262:

From 5 minutes to 1 hour	89.41 per cent.
" 6 hours	9.22 "
Over " "	2.67 "

In twin pregnancies, premature labor is frequent enough, and, strange to say, oftener in multiparæ than in primiparæ. In 143 cases of premature labor, collected from various sources, the following are the data:

Hoffman	29 nulliparæ.	28 multiparæ.
Reuss	45 "	98 "
Sinclair and Johnston .	73 "	160 "
Kleinwachter . . .	45.9 per cent.	54.9 per cent.

It is further to be noted that the mortality in case of twins is high, *viz.:* Reuss 10.4 per cent.; Collins 11.6 per cent.; Churchill 25 per cent.; Hugenberger 19 per cent. Chiari, Braun and Spaeth give a lower rate, 4 per cent.

The following tables show the relative frequency of various presentations, and the sex of the twins:

Frequency of Presentations.

	Reuss.	Kleinwachter.
Both fetuses longitudinal .	87.20 per cent.	89.90 per cent.
One fetus longitudinal, the other transverse	12.31 "	9.63 "
Both transverse . .	.49 "	.33 "
" vertex . . .	61.33 "	69.58 "
" breech . . .	32.2 "	25.25 "
" shoulder . . .	6.65 "	5.27 "

Sex of Fœtuses.—(151,397 children.)

Both males	50.140 times
" females	46.370 "
Male and female	54.841 "

This table justifies, in a measure, the current opinion that the children are usually of the same sex, but this opinion is not absolute by any means; for, on careful sifting of statistics, it is seen that the reverse is very frequently the case. Thus:

At Wurzburg,	In 57	per cent.	same	sex.	In 43	per cent.	not.
Spaeth .	“ 70	“	“	“	“ 30	“	“
Veit . .	“ 64	“	“	“	“ 36	“	“
Churchill .	“ 62	“	“	“	“ 37.5	“	“
Collins .	“ 60	“	“	“	“ 40	“	“

What now should be the rule in case of twin labor? We resume, in a few words, our own practice, which is none other than that of our teacher, Depaul: If the two fœtuses present well, if the first labor has been normal, we wait. If, at the expiration of fifteen minutes to one half an hour, contractions do not recur, then make friction over the uterus, and gently stimulate the cervix. If these means do not suffice, then rupture the membranes, and again wait. Extract in case of urgency. If, on the other hand, the presentation of the second fœtus be faulty, in case of the breech, wait, in case of the shoulder, version, external or internal according to the case. Whatever the presentation, interfere at once if the interests of mother or child demand it.

CHAPTER XIV.

THE THIRD STAGE OF LABOR.

THE third stage of labor consists in the expulsion or in the removal of the placenta and the membranes, that is to say, the annexes of the fœtus. This third stage may be spontaneous, the placenta and membranes being expelled through the efforts of nature, without interference. It may be natural, where the accoucheur assists only by a little traction. It may be artificial, where the accoucheur is obliged to interfere. We recur to this under the head of Dystocia.

Spontaneous Termination.—That this may be absolutely so, those cases prove where the ovum is expelled entire (fœtus, membranes, placenta, together), or where, at the end of twelve, twenty-four or even more hours, the placenta is born unaided. Such cases are usually of miscarriage; but there are a few instances on record of the birth of the fœtus, membranes, and placenta together. When not interfered with, the duration of the third stage of labor is very variable. Clarke, and most authorities, place it at from a quarter to one half an hour. The researches of Dubois, Cazeaux, and Depaul, however, prove that such an interval is entirely too short, and that the mean duration is from one to two hours. Stolz tells us that the third stage may be prolonged for from twenty-four to fifty hours. In such instances, active pains and hemorrhages have been noted, and the undelivered women have been restless and anxious. This, of course is objectionable. Spontaneous delivery, it seems to us, is not so rare as is believed; often has it happened to us, while occupied with the child, to be called by the woman, in from ten to fifteen minutes, and being told that something has passed from the vagina, to find the placenta in the bed either entire, or with the membranes alone in the vagina. Nevertheless, since such cases are exceptional, and since prolonged waiting has its objectionable points, the rule is not to await the spontaneous termination, but to resort to natural delivery so soon as this is possible or indicated.

Natural Termination.—Those authorities are in error who teach that the placenta begins to detach itself from the uterus during labor, or, as some contend, at the very beginning of labor. If this statement were true, during the course of labor, we would see more or less blood escape from the vagina, and this is not the case. Normal labor occurs without any hemorrhage whatever, and it is only in those cases where the placenta separates prematurely, that we see, at the end of labor, just before the expulsion of the fœtus, a slight trickling of blood from the vulva. Ordinarily, indeed, it is only at the expiration of a variable interval, that we see this trickling at all.

[It is self-evident that Charpentier uses here the term hemorrhage in its broad sense, for it is certainly exceptional for the second stage, at least, to be completed without any loss of blood. We make this point here because the positive statement has been made that, during the course of normal labor, the woman ought not to lose a drop of blood. The experienced will simply laugh at such a statement; the inexperienced need to be told that the reverse is the truth.—Ed.]

The uterus diminishes in volume, and retracts as it gets rid of the child, but this retractility does not become at all marked till a few minutes have elapsed from the birth of the child, and then it is that the third stage of labor begins. Three concurrent phenomena indicate the onset of this stage: 1st. Recurring uterine contractions, identical with those of labor, except that they are a trifle less intense. 2d. Change in the form, volume, and consistency of the uterus. This is apparent to the hand resting over the uterus, which hardens, becomes rounder, in a word, contracts. 3d. The appearance at the vulva of blood in greater or less amount.

If now, for us, uterine retractility plays a part in the detachment of the placenta, this part is incomplete without contraction, and these two phenomena, retractility and contractility, acting together complete the third stage of labor. To the three signs just mentioned, Caillaut adds another, which he says is perceptible on auscultation. He calls it the bruit of placental separation. "If," he says, "the child being born, the stethoscope be at once applied to the hypogastrium, at the end of a few minutes are heard a few indistinct sonorous râles. At the same moment the uterus contracts. These râles increase, and will be found to be synchronous with the contractions of the uterus."

Although Baudelocque and Velpeau granted but two phases of the third stage, to-day we recognize three: 1st. Separation of the placenta; 2d. Its passage through the cervix; 3d. Its passage through the vagina and vulva.

The Separation of the Placenta.—The separation of the placenta does not include the membranes alone. We have seen that, together with the placenta, the uterine mucous membrane is shed as the decidua. This decidua, the maternal placenta, includes the entire superficial portion of the uterine mucous membrane. This shedding is not effected suddenly, but slowly and progressively, the efficient cause being the retractility and contractility of the uterus. The retractility first comes into play. Emptied of the fœtus, the uterus tends to reduction in size and in capacity, and this can only happen through the retraction of its walls, from which results diminution in the size of its cavity. Now the placenta is a spongy, vascular, non-contractile body, and can only follow this retrograde movement of the uterus to a degree. The limit once attained, it is compressed on itself, and, the retractile force continuing, the cellulo-vascular adhesions, which unite it to the uterus, break, and the superficial portion of the mucous membrane yields at one point, exposing the uterine sinuses. From these sinuses escapes blood at the level of separation, and this blood, increasing in quantity, tends to increase the separation. The placenta thus becomes more and more a foreign body. Now the contractility of the uterus in turn plays its part, and, at the outset, completes the separation, later determines the expulsion, or at least the passage, of the placenta through the cervix. This process of separation does not always occur after the same manner, and it varies according to the point of placental insertion. It is generally granted that, when the point of insertion is at the fundus, the placenta begins to separate at its centre, because this centre is the thickest portion, and consequently less able to follow the retreat of the uterus. Separation then proceeds from the centre to the circumference, forming a cavity, as it were, in which the blood accumulates. The fœtal surface of the placenta tends more and more to approach the internal orifice of the cervix, and when complete separation has been effected, it will fall on this orifice by the same surface, carrying behind the membranes and the decidua, these latter being turned inside out like the finger of a glove, and making a pocket containing more or less blood and clots. If, on the other hand, the placenta is inserted on one of the uterine walls, anterior or posterior, this separation, instead of beginning at the centre, begins at one or another edge, and, progressing after this manner, the placenta may appear at the cervix either by its fœtal or maternal surface. If the separation proceeds from above downward, the placenta will present by its fœtal surface, but in case of the separation beginning below, and extending upward, then remaining, as it will, adherent lastly at its upper border, the placenta will slide along the uterine wall, and will present either by its lower border or by the maternal surface. As a result, in the first instance, the blood will appear externally after the birth of the placenta, since it is retained in the pocket formed by the membranes; while in the second instance, the blood will appear externally as soon as separation begins.

The above process of separation, admitted by all authorities, has latterly been questioned by Matthews Duncan. According to him this inversion is due to tractions exercised on the cord, and, if we take as typical spontaneous delivery, we note that the portion of the placenta, which first presents at the cervix, and, in consequence, at the vagina, is not the amniotic or fœtal surface, but the border or a portion at some distance from this border. "When the border does not exactly present, this is not because the placenta is turned inside out, for only a small portion of the mass is in fact so turned. It is in reality the border which presents, but this border is slightly thickened, because it is turned up, and especially do the placental borders turn up in cases where they are thin. It is the still adherent membranes, which, making traction on the circumference of the placenta, determine the presentation, for the force necessary to detach them is greater than the resistance offered by the border of the placenta. These points are confirmed by the researches of Ritgen and of Lemser. If the placenta is expelled after the manner described by Baudelocque and Schultze, there must needs occur considerable hemorrhage. The placenta, being in a measure a rigid body, it cannot turn on itself, take the shape of a cup, with the resulting cavity in which the blood accumulates. The force which is called into play to produce such an inversion tends at the same time to cause hemorrhage from the open uterine sinuses, which were applied against the surface of the placenta which has inverted. If the placenta detaches itself by presentation of its border, its uterine surface slides along the wall of the muscle, and there exists only a small space to receive the blood which flows from the uterine sinuses. The muscular walls of the uterus remain close to the placental surface, the uterus contracts, pushes down the placenta, and soon it becomes almost spherical and empty. Hemorrhage, then, is no longer a consequence of the mechanism of labor."

Devilliers is inclined to think that the point of insertion of the cord to the placenta has much to do with the mechanism of separation, which begins rather at the centre when the cord is inserted here, as is usually the case; while it begins near the placental border when the cord is inserted near the margin.

Expulsion and Passage of the Placenta through the Cervix.—Separation once accomplished, the placenta becomes a foreign body, against which the uterus tends to react. Contractility, hence, begins to play its part. This is manifested by the hardening of the uterus, which, changing its shape, projects through the abdominal wall; and this uterine contraction, being accompanied by pain, the woman complains, and the accoucheur knows that the third stage of labor is about to begin. Under the influence of these contractions, the cervix opens at the internal os, and the placenta tends to engage within it. If, now, a vaginal examination be made, the finger touches a body, easily recognized as the placenta by the projection of the umbilical vessels, and the insertion of the cord. If the third stage be left to the efforts of nature, the uterine contractions, increasing in intensity, push this placental mass through the cervical canal, and contractility and retractility combining their forces, the placenta falls out of the cervix into the vagina, carrying with it the membranes which, in turn, detach themselves from the uterine wall.

Passage through the Vagina and through the Vulva.—Once in the vagina, the placenta meets with no further resistance, and gentle traction suffices for delivery. If this delivery be left to nature, at the end of an interval, which may vary from ten minutes to many hours, the vagina in turn contracts and expels the fœtal annexes. But, remembering the objections to this method which we have already mentioned, it is customary to extract the placenta. This extraction, as is apparent, offers no difficulties in a normal case, since the placenta is in part engaged in the cervix, or has fallen into the vagina.

Operative method.—The tractions, which should be made on the cord, must be made after strict rule. Formally, authorities were in favor of seizing the cord, covered by a cloth to prevent slipping, in the right hand; then, to follow up the cord as far as possible with two fingers of the left hand, and through traction to make the cord glide along these fingers which are pressing it down against the vagina. For our part, we believe this procedure useless, and our method is as follows: The left hand is applied on the fundus of the uterus, in order to follow the retreat of this organ, and to make sure that this retreat is normal and regular; whilst the right hand seizes the cord, a towel intervening, approaching the vulva as the placenta descends. As soon as the placenta reaches the vulvar cleft, the cord is released, and, seizing the placenta with the entire hand, it is twisted several times on itself in order to form, with the membranes, a species of cord more resisting, and therefore less likely to break.

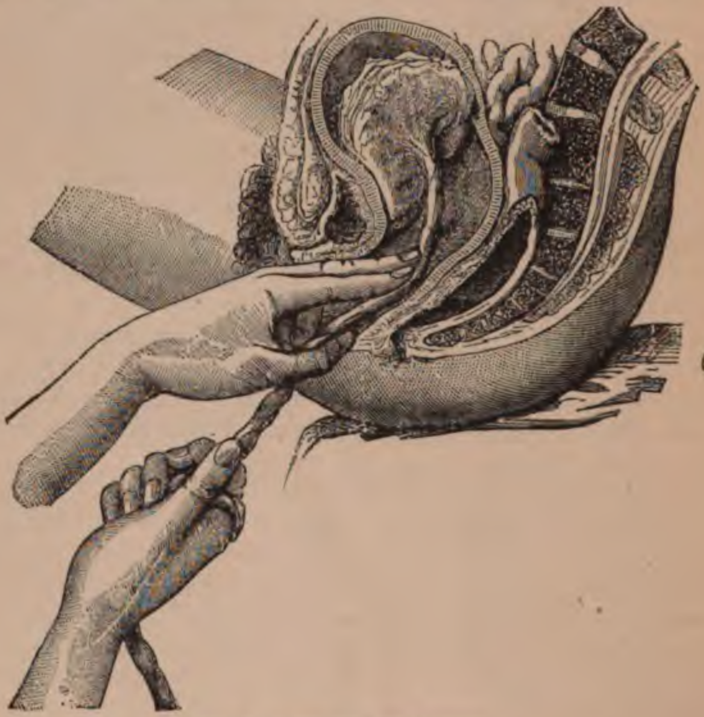


Fig. 241.—Extraction of Placenta.

We are thus assured that these membranes are entirely intact when they issue with the placenta, and that no shred remains within the uterus or the vagina. The placenta delivered, it is laid on its uterine surface, and the membranes are lifted off the fœtal surface, that we may assure ourselves that they and the placenta are intact.

In Germany, Credé has given his name to a method of delivery, which, after having been accepted with enthusiasm, is to-day decried, and with just reason, by a large proportion of the authorities. This method is called Credé's method of placental expression, but in reality it belongs to Hardy and McClintock, and consists in the following steps: Wait for the first uterine contractions occurring after the expulsion of the fœtus, and grasp with the entire hand the fundus of the uterus, massaging it, compressing it with the fingers, thus causing an artificial separation of the placenta, which, according to Credé, will make its exit from the uterus, driven from the uterine cavity, and expressed, so to speak, even as a cherry-stone is squeezed from between the compressing fingers.

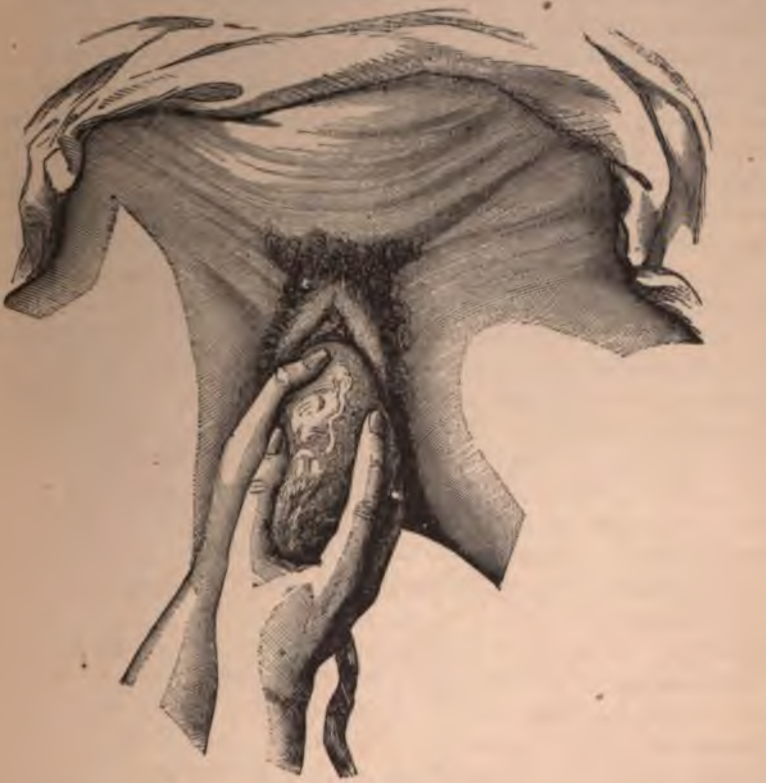


FIG. 24.2—REMOVAL OF THE PLACENTA.

According to Credé, we thus avoid the hemorrhage of the third stage of labor and this manœuvre adds in no wise to the woman's suffering.

For our part, we are opposed absolutely to this method, which not only cannot be resorted to as Credé wishes, but, furthermore, is far from being non-injurious to the patient. Placental delivery (practised after Credé's method) is no longer natural delivery, but is to the highest degree artificial delivery. The rules laid down by Credé are in reality the following: Await not only the retraction of the uterus, but the return of the contraction, and then only to act. Now, if we analyze the tables prepared by Credé and his pupils, those of Chantreuil, for instance, who for a time was a pronounced partisan of this method, we see that delivery by expression is resorted to even within three or four minutes after labor. Now all authorities agree, and with reason, that if uterine retractility manifests itself within the first few minutes after the birth of the fetus, the same does not hold true of uterine contractility, which does not recur, ordinarily, before eight to ten minutes have elapsed. This theory therefore, is strikingly opposed to practice.

Furthermore, we would add that we do not believe that massage of the uterus, exercised at a time when this organ, worn out by the efforts which it has made to give birth to the fœtus, needs gentle management, is inoffensive to the woman. Further still, the very German authorities who have shown themselves partisans most loyal to this method, have reported a number of cases of metritis and of peritonitis consecutive to such interference more or less brutal. Let us add, finally, that this method in no sense protects women against hemorrhage, and that, in many instances, there have remained within the uterus shreds of membrane, and even portions of the placenta.

[In view of the nearly uniform belief, teaching, and practice of distinguished accoucheurs throughout the world to-day, with whose writings every physician must be familiar, it seems unnecessary to give here the convincing arguments which at once suggest themselves in reply to the position so forcibly held by Charpentier. Furthermore, the description given by him of Credé's method is the reverse of the truth, as we understand and practise the method, and as we know it to be understood and practised by Credé and his followers in Europe and in this country. Credé's method, rightly followed, is, above all other methods of placental delivery, rational, in that it simply assists the natural process of separation of the placenta, and further is safer for the woman, in that it secures those desiderata which every accoucheur aims at—a thoroughly emptied and an efficiently contracted uterus. Delivery of the placenta by traction on the cord cannot be too strongly condemned. It does not imitate Nature's method, which is one of *vis a tergo*, not of *vis a fronte*. It is especially dangerous in those not very rare instances where there exist morbid adhesions between placenta and uterus. Here there is possibility of uterine inversion, there is strong probability of placental or membranous shred remaining in the uterus. And, be it remembered, in no given case does the accoucheur know that such morbid adhesions do not exist. For such reasons, mainly, have the majority of obstetricians rejected traction on the cord, and substituted placental expression. The wood-cut, therefore, descriptive of the former, it is hoped, will prove a warning as to what the accoucheur ought not to do.

And what, rightly stated, is Credé's method of placental expression? At the outset, the uterus is never to be spurred into action by massage or by kneading, but the hand is to be kept quietly on the fundus, until the uterus is felt to harden, not faintly, not irregularly, but uniformly and strongly. Then expression is to be brought into play, and never before. The mean interval between the birth of the child, and correct resort to Credé's method, varies from fifteen minutes to one half hour—the latter figure is a nearer approach to the truth. Failure in the use of Credé's method is due to the fact that efforts at expression are made too soon—before fifteen minutes, at least, have elapsed since the end of the second stage of labor. When the uterus is distinctly felt to harden, friction should at first be made over the fundus, and then the uterus is grasped by both hands, the fingers towards the pubes, and compression is made. If this first effort at expression fails, wait for a second, it may be a third or fourth contraction. The compressive force must be directed as far as possible in the axis of the uterus, in order to act to the best advantage. Thus now, except where there are morbid adhesions, the placenta may be forced into the bed, between the patient's thighs. It will be noticed that, by this method, absolutely no handling of the cord and no vaginal examination are necessary. Indeed, in a normal case, where membranes and placenta are intact, the finger need never be introduced into the vagina after the completion of the second stage of labor. The placenta delivered, too much stress cannot be laid on the fact that it must be twisted on itself, over and over again, in order that the membranes may be extracted entire. Inattention to this fact is a very common cause of retained shreds of membrane.—Ed.]

With the birth of the placenta there is a loss of blood, but the amount is variable, limited in general to ten to twelve ounces, although this loss may amount to as much as thirty ounces. The amount, it is apparent, will depend on the development of the vascular system of the uterus, and on the retractility and contractility of this organ. In general abundant, when the uterus retracts and contracts moderately, the loss of blood is, on the contrary, very slight when the uterus contracts energetically, as is usually the case when the third stage is completed spontaneously. The same holds, and the reason is evident, when the fœtus is expelled a few days after its death, the utero-placental circulation having nearly, or almost, ceased. When, on the other hand, towards the end of labor, the uterine contractions are feeble, when the uterus is greatly distended, as in case of hydramnios, twins, very large fœtus, etc., then the uterus is deficient in retractile and contractile power, and hemorrhage may be great. It is in cases such as these that we meet with those frightful hemorrhages, of which we will speak in connection with the subject of the complications and the accidents of labor.

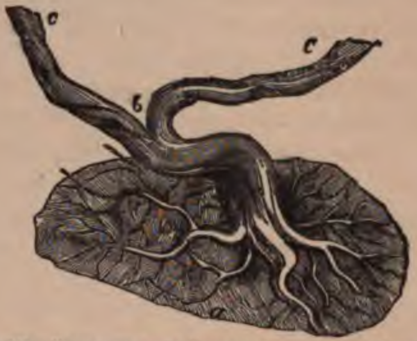


FIG. 243.—PLACENTA WITH BIFURCATED CORD. (After *Busch.*)

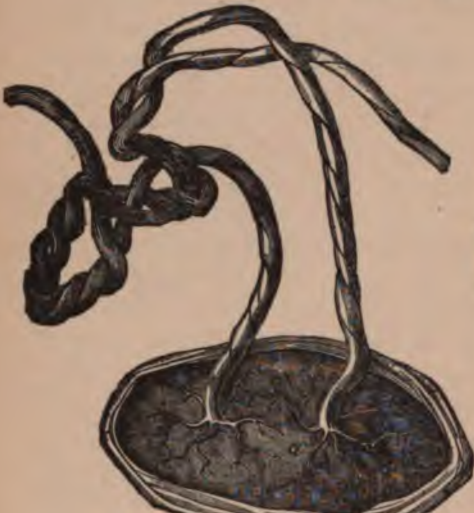


FIG. 244.—PLACENTA OF TWINS.

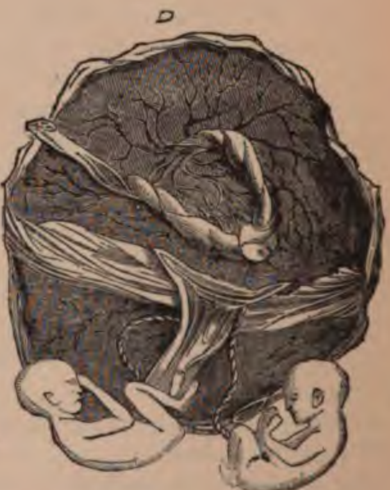


FIG. 245.—PLACENTA IN A CASE OF TRIPLETS.

Delivery of the placenta in twin pregnancies.—The reasons for not interfering too soon during the third stage of labor are all the more applicable to twin pregnancies: But with Naegelé and Grenser we are opposed to the practice of making traction on both cords at once. In the first place, the placentas are frequently separate, and the one detaches itself before the other. Further, when the two placentas are united, pulling on both the cords will make trouble, in that the placenta masses will endeavor to engage at the same time. The best practice is to search for the cord belonging to that placenta which tends to engage, and, as soon as this placenta has reached the os, to make traction on the cord belonging to it. [It is obvious, from what has gone before, that here, as well, Credé's method of placental expression will answer better than any such tractions on the cord.—Ed.] But we must watch with all the more care over the delivery, for hemorrhage, the result of uterine inertia, is common in such cases.

We represent here, figure 243, a curious example of the cord observed by Busch in a case of twin pregnancy, and in figure 245 the disposition of the cords and the placentas, in a case of triplets, observed by Martin.

CHAPTER XV.

ANÆSTHETICS IN NORMAL LABOR.

ETHER AND CHLOROFORM.

CHARPENTIER'S conclusions in regard to the use of these anesthetics are preceded by a *resumé* of the views held in regard to them since the introduction of anæsthetics into obstetrical practice by Simpson in 1847. Since both the usefulness and safety of both ether and chloroform in the lying-in chamber are now universally admitted, we omit this *resumé*, and reproduce simply the general conclusions.—Ed.]

Chloroform in labor is administered either in surgical or in so-called obstetrical dose.

Surgical dose.—It is thus uniformly used: 1st. Whenever an operation is to be performed—forceps, versions, etc.—and anæsthesia should be as complete as the operation is difficult or dangerous. 2d. Whenever the pains are unbearable, and the parturient is, in consequence, greatly excited and uncontrollable. 3d. In case of spasm of the uterus. We refer here simply to rigidity of the cervix, not to tetanus of the uterus. 4th. In case of eclampsia.

Obstetrical dose.—1st. Chloroform given in small dose unquestionably takes the edge off the pains, and thus gives the parturient both moral and physical strength. At the same time the intervals between the uterine contractions are lengthened. 2d. Complete analgesia we have never observed except under deep anæsthesia, and then the drug is administered in surgical dose. 3d. At times chloroform, instead of quieting, excites the patient to such a degree that we are obliged to cease its administration. 4th. Occasionally, it has seemed to us, that chloroform diminished the contractile power of the uterus, and therefore caused hemorrhage, more or less grave. 5th. Its action on the fœtus is *nil.* 6th. Administered during the period of expulsion, chloroform certainly diminishes pain; but its effect on the contractions of the abdominal muscles, and the resistance of the perineum, has seemed to us less marked than is generally supposed. Pain is not completely abolished, contractions are frequent.

Never would we administer chloroform in normal labor except in the instances noted above. There is another anæsthetic to which we often have recourse, and which has frequently rendered us yeoman service. We refer to chloral.

[It will be noticed that no reference is made to ether by Charpentier. This, of course, is because the safety of ether over chloroform is not as yet recognized in France. True enough, chloroform administered in labor, is safer than when it is given apart from this physiological act, for the reason that the uterine contractions tend to prevent the cerebral anemia, which is such a constant accompaniment of fatal cases. In this country, however, particularly in New-England, the birth-place of ether, it is considered much the safer plan not to administer chloroform, but always ether. Owing, however, to the longer time requisite for the administration of ether, and the inability to give it intermittently as easily as chloroform, the former is best reserved for operations requiring considerable time, and in cases of eclampsia. Of all the stages of labor, chloroform is most useful when the second stage is about ended, and, if it be then pushed to the surgical degree, the chances of securing an intact perineum are greatly enhanced—the accoucheur being able to shell out the presenting fetal part as slowly and as carefully as seems requisite.—Ed.]

Chloral.—This drug, of which we will speak further on under the head of eclampsia, is worthy of the attention of obstetricians. We have seen that the partisans of moderate anæsthesia resort, in particular, to chloroform during the stage of expulsion, and, for us, this period, although perhaps the most painful, is not the most insupportable. It is then that the parturients take account of the progress of their labor, regain courage, listen readily to the counsel of their physician, and are, in reality, less irritable and excitable, except perhaps, during the last contractions, than during the first stage of labor. It is impossible to keep the woman under chloroform from the beginning of labor until the expulsion of the fœtus without danger; now it is during the first stage of labor, that is to say the period of dilatation, that chloral has appeared to us incontestably of utility. When the pains in the back are very pronounced, or dilatation is slow, either because of feeble or irregular pains, or because of rigidity of the cervix, in primiparæ for example, then it is that we have used chloral. We give it by enema, about one drachm at the outset, and repeating this in some four or five hours. We thus procure for our patients more or less rest, sometimes deep sleep. The drug has never seemed to us to have a bad effect on the pains, but rather to make them regular, without diminishing the intensity. In three cases which we recall, there existed spasmodic rigidity of the cervix, lasting for some five to six hours, which yielded in one half an hour to the chloral enema. In the second stage of labor, the expulsory stage, the action of chloral has seemed to us less marked. We then have recourse to chloroform, even as when manual or instrumental assistance is called for, which must be administered in surgical dose.

[As a further anæsthetic of utility in labor we would refer to cocaine. A number of observers have reported excellent results from the application of this drug to the cervix during the first stage of labor. It is not likely, however, that cocaine will supplant chloral in this stage, whilst, during the expulsory stage, we question very much if it would have any effect whatever.—Ed.]

CHAPTER XVI.

THE CARE OF THE PATIENT IMMEDIATELY AFTER LABOR.

THE first desire of the newly delivered woman is for absolute rest, and this should be granted her before we proceed to cleanse the genital and the bed. If the third stage of labor has been conducted after the manner we have outlined, the accoucheur has, on the one hand, assured himself that the uterus does not contain a second fœtus, and, on the other hand, that this organ has thoroughly contracted, and that he need not fear uterine inertia, or hemorrhage, or inversion. His duty now is to see that this contraction is being maintained, and, for this purpose, it suffices to palpate the abdomen from time to time. If the uterus be at the level of the umbilicus, if it be hard, spherical, and resisting, if no blood flows from the vagina, all is right; if on the other hand, the uterus be soft and relaxed, gentle friction over the fundus may suffice to expel clots, and to obtain the contraction which is a necessity. Of course, we are supposedly speaking of a normal case. For the complications of delivery we refer the reader to this heading. Usually, at the end of a few minutes, the woman has a chill, which is of no import, depending purely on change in vascular tension. It is only necessary to slip a dry sheet under her, to cover her a little more, keeping her on the back, the legs together, and amidst perfect quiet. The administration of a little stimulant, in addition, soon dispels the chilly sensation. At the end of about one half hour, according to circumstances, we proceed to the toilette, and careful examination of the genital organs. This toilette should be attended to with the greatest possible care, the genitals being washed with luke-warm water, to which is added a little alcohol, or tincture of arnica. We prefer a dilute phenic acid solution. Now, if the night dress be soiled, let it be replaced, as quietly as possible, by a dry and warm one. Over the abdomen a folded towel should be placed, and this we prefer to the binder. We thus obtain equable compression, and we prefer the compress to the binder, for the reason that the patient must lie quietly on her back, else the compress will slip off. [Nothing adds so much to the comfort of the puerpera, as a neatly applied and gently compressing abdominal binder. No wonder, when we remember that for months the abdomen has been enormously distended, that the patient feels the need of a certain amount of compressive force. Undue compression is of course to be avoided, else the tendency will be to force the uterus back towards the sacrum, placing the suspensory ligaments of the organ under great strain, and making it

[illegible] Prac.

likely the patient will, at the end of convalesence, have a retroversion.—Ed.] The puerpera should now be left alone with the nurse, and absolute quiet should be enjoined, in order that sleep may be uninterrupted. When she awakens, a little bouillon may be given to her. The physician should remain with his patient at least one hour after delivery, where the labor has been normal. In case there has occurred hemorrhage during the third stage, then the woman should not be disturbed for a number of hours, even for the purpose of cleansing her or the bed, and the physician should remain by her until he feels absolutely certain that danger of uterine inertia no longer exists. Certain accoucheurs are in the habit of administering, routinely, about fifteen grains of ergot by the mouth, or by the rectum. We believe this to be an unnecessary precaution. If there be no tendency to inertia, the administration of ergot is useless, and only excites after-pains and therefore disturbs the rest which the woman needs; if inertia has existed, ergot is useless, for, as we will see, it is at the outset necessary to empty the uterus of clots, and ergot should never be given until the uterine cavity contains neither clots nor blood. There is one rule, which, for us, is absolute: the accoucheur should always revisit his patient in from five to six hours after delivery.

[The practice of administering ergot immediately after the delivery of the placenta, as a routine measure, we believe to be a wise one. Not only does ergot tend to keep up firm and equable contraction, but by so doing it also assists the process of involution. In no given case can the accoucheur feel that the uterus will not relax, and we may efficiently guard against this by giving from one to two drachms of the fluid extract of ergot before we leave our patient. Where the stomach is irritable, the drug may be given by rectal suppository, as the aqueous extract (five to ten grains.) Further still, we believe it good practice to continue the ergot for ten days after delivery, giving fifteen to thirty drops three times a day. The object of this is to assist involution. If the drug seems to cause after-pains, these pains are salutary, usually, since they may mean that the uterus is endeavoring to expel clot. These pains are rapidly quieted by a small dose of chloral hydrate (fifteen grains by mouth, or thirty grains by rectum.)—Ed.]

CHAPTER XVII.

THE CARE OF THE NEW-BORN INFANT.

AS soon as the infant is born, we should satisfy ourselves that the cord is not around the neck or the limbs, and remove from the mouth any mucus which might interfere with respiration. If the cord be not around the neck, the infant is placed between the mother's knees, and the mouth is cleansed by the finger. In case the cord be around the neck or the limbs, it is carefully disengaged, taking care not to make traction on it. If there be any difficulty in disengaging it, the loop should be cut between the fingers and a temporary ligature applied.

[Before further attention is given to the cord, a very important step, in our opinion, is to care for the infant's eyes. These should be at once thoroughly washed with lukewarm water, and; in hospital practice, as a routine measure, in private practice whenever there is a suspicion of gonorrhea in the mother, a drop of a two per cent. solution of nitrate of silver, should be instilled into each eye, the lids being well separated for this purpose. At this writing, it is unnecessary to refer to the excellent results obtained by this procedure in the prevention of ophthalmia neonati. Credé, to whom we owe the method, proves this amply in his writings, and since the adoption of the method at the New York Maternity it is exceptional to meet with a case of ophthalmia.—Ed.]

The cord is ligatured as follows: Stout string is necessary in order to thoroughly compress the umbilical vessels. If the cord be thin, nothing more than the ligature is requisite; if, on the other hand, it be thick, then Wharton's jelly should be stripped from the cord, towards the placenta, before ligating. The ligature should be passed around the cord, and tied in a single knot, and then passed back and be double-knotted. On the placental side a ligature should also be placed, and we cut between. On the fœtal side the ligature should be applied about one inch from the navel, and, after the cord has been cut, we must make sure that it does not bleed, and that the ligature will not slip. In case the cord bleeds, a second ligature should be applied below the first, as far as possible, however, from the navel. The infant should now be wrapped up, and handed to the nurse to be clothed and bathed.

Latterly, the point has been much discussed as to when it was advisable to tie the cord. Some authorities counsel ligature immediately on the birth of the infant; others, to wait until pulsation has ceased. Budin has again opened this discussion. Among those favoring the former plan may be mentioned, Cazeaux, Depaul, Verrier, Pinard, and those holding the reverse opinion, are Stolz, Naegelé, Schroeder, Leishmann, Jacquemier. According to Budin, immediate ligature means depriving the infant of about 80 minims of blood. At least one to two minutes, therefore, should be allowed to elapse, after the cord has ceased to pulsate, before ligating. At the moment when external life succeeds intrauterine, the lungs dilate, and the air and blood penetrate. The afflux of blood to the lungs is proved by their increase in weight, and the blood, returning by the umbilical vein, passes through these organs into the general circulation. Now, as long as the cord pulsates, as long as the utero-placental circulation lasts, after each beat of the heart, a certain quantity of blood is driven through the umbilical arteries into the placenta. The fœtus sends to the placenta a portion of its blood, and Budin concludes that, even where the infant is born asphyxiated, it is not advisable to let the cord bleed, but to apply the ligature, and begin artificial respiration. Kohly, Brunon, Helot, in 1876, following the researches of Budin, and adopting his ideas, pronounce in favor of tardy ligature, because the child thus receives more blood. Budin's opinion has given rise to much discussion. Zweifel goes so far as to advise no ligature to the cord until the placenta is expelled. Meyer has found that there was only a difference of 2.69 per cent. in the amount of blood in the placenta after immediate and after tardy ligature, while Zweifel found a difference of three ounces. Hofmeir finds this result of Zweifel's much exaggerated. He examined ninety cases with reference to this point. In fifty tardy ligature; in forty immediate. He concludes that in case of tardy ligature the infant loses ten per cent. less of its weight than in case of immediate ligature. Porak and Ribemont have lately gone over this question thoroughly, and the general conclusions they have reached, are: 1st. Tardy ligature ensures to the infant an extra quantity of blood, amounting to about two and a half ounces. 2d. The blood contained in the placental vessels is necessary to the circulatory system of the infant. 3d. The cause of the entrance of this blood into the fœtal circulatory system, is, in particular, thoracic aspiration. The pressure of the uterus is purely an adjuvant and secondary cause. 4th. Immediate ligature, and bleeding from the cord, should not be practised in case of venous asphyxia of the new-born. 5th. Tardy ligature does not expose the infant to any danger, whether immediate or remote. 6th. The new-born, through tardy ligature, loses less in weight, and regains what it does lose more quickly. 7th. The delivery of the placenta would seem to be facilitated through tardy ligature. 8th. Ligature and section of the cord should never be resorted to until pulsation in it has ceased.

Steinmann, in 1881, further studied this question, and the conclusions he reaches from his experiments are nearly the reverse from those stated above. What in general, then, are we to conclude from these varying experimental studies? That it is of advantage not to hasten the third stage of labor, and this means the rejection of Credé's method. [That Charpentier is in error is apparent from our previous statements in regard to Credé's method. We repeat again, that Credé's method does not hasten the third stage of labor, if rightly performed.—Ed.] The cord should not be tied till pulsation has ceased. But is the advantage thus gained as great as Budin, Ribemont, and the partisans in favor of tardy ligature, insist? We do not believe it. During its first life days the infant is subjected to too many influences which may alter its weight, to warrant us in laying the entire increase to the credit of tardy ligature. In our opinion, the infant's increase in weight depends rather on the manner and method of its feeding. The amount of milk absorbed by the infant, during the first few days is not always the same, even in perfectly healthy infants. The infant which receives an abundance of milk, which nurses long and vigorously, will always lose less in weight, than the infant under different conditions. It is not sufficient, therefore, to weigh the infant, but we must also compare the quality of milk furnished, and the quantity taken by the infant, not only in twenty-four hours, but after each nursing, or at least obtain the mean amount; we must further weigh the excrement passed by the infant, for thus alone can we obtain all the factors in the problem. The infant, under perfect hygienic and alimentary conditions, not only will lose less in weight, but will also gain more rapidly, than under the reverse conditions. As for the icterus on which Porak lays stress, we may generally affirm that it is chiefly in case of feeble, poorly-developed, premature, incompletely, and insufficiently nourished infants, that we see this icterus. As for bleeding from the cord, we will refer to this shortly.

The cord having been tied, the nurse should rub its body with grease or oil to remove the vernix caseosa, and then place it in a warm bath. The physician should assure himself of the temperature of this bath, and it ought not to range above 90° F. Simpson has pointed out the danger to the infant of placing it in a hot bath. At the end of a few minutes, the infant is removed from the bath, wiped perfectly dry, powdered from head to foot with rice-powder. The cord is then to be dressed as follows:

It is passed through the centre of a greased piece of linen, which is wrapped around it, and the cord is then laid against the left side of the abdomen, and over it the binder. [A neater method of dressing the cord is to wrap around it a piece of absorbent cotton. This will cling efficiently, and, not having been greased, the cord is kept dry, and mummification progresses to better advantage and without odor.—Ed.] We now proceed to dress the infant, and the clothing varies according to the country. The main thing is that the infant be warm. The infant's head should be covered and kept warm, and it is to be placed in its crib, and bottles filled with hot water placed under the crib covering. [We would advise rather that the infant's head be not covered, as is often the case, by the bed-clothes. The child needs pure air, and this it cannot obtain with covered face. We have never seen any harm result from never covering the head, whether awake or asleep and letting the child breathe the atmosphere of the nursery. In this country, where means for heating our houses are more perfect than in France, it seems unnecessary to place hot water bottles in the infant's crib.—Ed.]

CHAPTER XVIII.

APPARENT DEATH OF THE NEW-BORN INFANT.

UP to the present, we have considered the infant as coming into the world strong and healthy, and requiring only ordinary care. But it is not always so, for the infant may be born feeble, before term, or in a condition of what has been termed apparent death.

1st. If the infant be born feeble, but breathing well, it requires no special attention. If, on the contrary, it breathes with difficulty, its body should be rubbed with a piece of warmed flannel: there should be added to the bath vinegar, wine, eau-de-cologne: the infant should be taken near an open fire—in a word, its skin should be excited in every possible way. Often fumigations with benzoin have given us excellent results.

2d. If the infant be premature, we must redouble our efforts to prevent its becoming chilled. The infant should be wrapped in cotton, and covered with flannel. The temperature of the room should be maintained at at least 80° F. Hot bottles should be placed around it in its crib, it should be dressed only before a fire, and, above all, it should have a nurse with an abundance of milk, and with projecting nipples. If the infant do not nurse during the first few days, the nurse should draw her milk, and feed it to the infant with a spoon. At the end of several days, the infant will usually take the breast and then it will survive, if it do not become jaundiced, or catch cold, and this it does the more quickly the further it is born from term. In other instances, the function of respiration becomes established but incompletely, cyanosis sets in, and the child dies a few hours after birth.

3d. Finally, we consider the state of apparent death. By this name we mean, with Martel, a peculiar state in which the infant is born, a state characterized by an arrest of the functions of animal life, and apnœa, with, it may be, only feebleness, or else cessation of the pulsation of the heart.

Apparent death is met with under two very different forms: 1. The anemic form: 2. The asphyctic or apoplectic form.

Anemic Form.—What strikes us at once is the pallor, the discoloration of the skin, and of the mucous membranes. The mouth open, the inferior maxilla falls of its own weight. The muscles of the body generally are in a state of complete relaxation. From the open anus flows the meconium, which soils the body of the infant. The eyes glassy, the pupils more or less dilated, are covered by the eye-lids, which are frequently a trifle open. The pulsations of the heart are scarcely audible, and are recognized only by gentle trembling over the cardiac region just appreciable to the finger and to the ear—at times, indeed, the pulsations are entirely lacking. The pulsations of the cord, usually absent, are in certain cases very weak; at long intervals the infant makes no respiratory movement; it looks like a diminutive corpse.

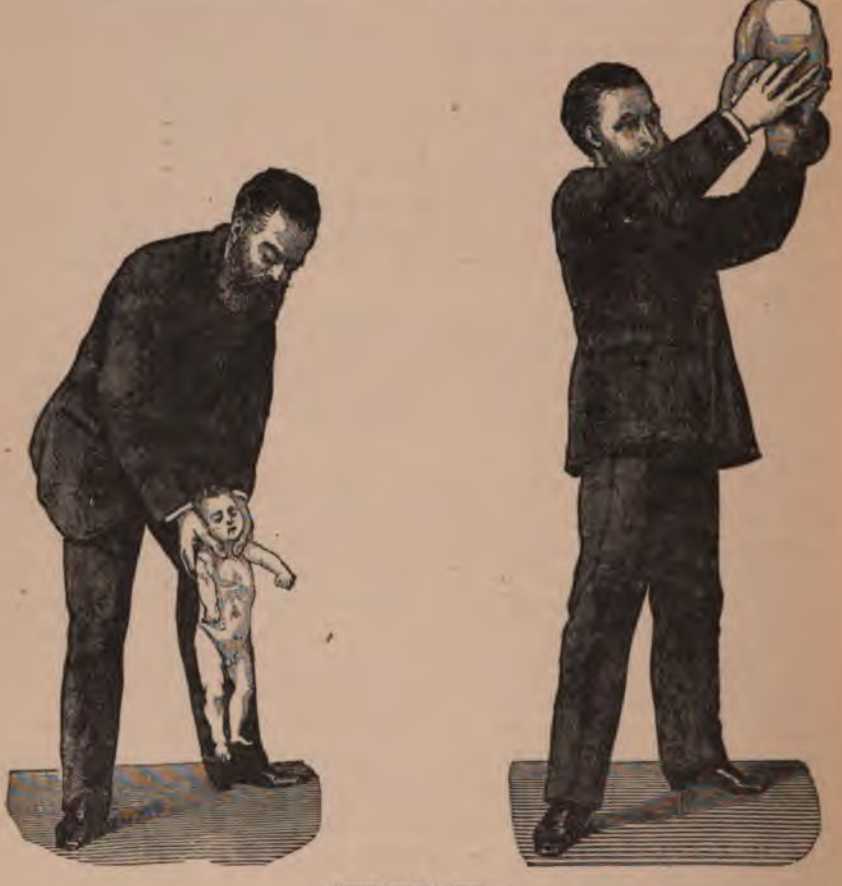
Apoplectic Form.—In this second form, the most common and fortunately the least fatal, the aspect of the infant is entirely different. Red, livid, almost brownish, especially towards the head, the infant presents the traces of congestion, more or less pronounced, and more or less generalized. The lips are swollen, the injected eyes project from the open eyelids, the mucous membrane of the mouth is bluish, the tongue swollen. The body is less relaxed, the limbs in certain cases being nearly rigid. The pulsations of the heart and the cord are less completely abolished than in the preceding form, and they may be heard over the cardiac region, but they are feeble, irregular, slow, and tend to disappear more and more; the cord is increased in size, the umbilical vein is gorged with blood.

The fœtus, in a condition of apparent death, may then appear under two forms apparently very different, but with this in common, complete absence of respiratory movements, with insensibility to external irritants. These two aspects of the new-born infant have been differently understood by the authorities.

While Naegelé, P. Dubois, Depaul, believe that the first form, the anemic, is met with in premature births, faulty development, serious disease of the mother, hemorrhages from rupture of the cord or the placenta, and that the second form, the apoplectic, is met with in case of compression of the head, of the cord, pelvic presentations, spasmodic contractions of the uterus, accumulation of mucus in the air-passages, etc., Jacquemier, and we agree perfectly with him, while admitting the influence of these different conditions, considers these two forms as different degrees, more or less advanced, of the same pathological state, asphyxia. This is the opinion of Tarnier, of Budin, of Ribemont, who reject completely, or nearly so, pulmonary and cerebral congestion, and consider these two forms as the result of asphyxia, sudden in the one case, the anemic form, slow and progressive in the other, the apoplectic.

Martel, on the other hand, believes that these two forms are entirely different. If the same cause originally produces them, the result is not the same. "Apparent death in the new-born may follow on asphyxia or enfeeblement of the heart. In case of asphyxia, apparent death has supervened progressively, but rapidly; in case of cardiac feebleness, asystole, it has, on the contrary, supervened slowly.

" In asphyxia, the blood circulates in excessive amount in the peripheral vessels, but it does not contain sufficient oxygen. On account of this deficiency in oxygen, the medulla cannot functionate at the hour of birth. Nevertheless, carbonic dioxide, through transient irritation, produces a few respiratory movements, but these are of short duration. In heart-failure, apparent death is present, because the heart is unable to project into the body the amount of blood necessary for the interchange of gases which takes place within the tissues; hence, if oxygen is absent, it is because the blood cannot reach the periphery, the capillaries are empty and contracted, the heart is unable to fight against their elasticity, and the central organs are gorged with blood. The first inspiration cannot be made, because the medulla lacks the quantity of blood necessary for its normal function."



SCHULTZE'S METHOD.

FIG. 246.—INSPIRATION.

FIG. 247.—EXPIRATION.

It is impossible for us to reject congestion as a factor as entirely as do Budin and Ribemont. If their opinion be correct for pulmonary congestion, it appears to us incontestible that we are dealing with something different in case of congestion of the nervous centres.

At the autopsy of children born apoplectic, we find the venous vessels of the brain and its membranes, the rachidian plexuses, the veins of the neck and of the chest, and the cavities of the right heart, gorged with venous blood. There are hemorrhages at the base of the brain, extending even into the ventricles, and we find local congestions in the lungs, the diaphragm, etc. If, on autopsy of anemic infants, the capillaries, and the peripheral parts of the body, are empty, the large cerebral vessels are gorged with blood, even as in the preceding form. It is apparent then, that we do not accept the opinion of Budin and Ribemont in the treatment of apparent death of the new-born, and we make a sharp distinction between the cases when the fœtus is blue, apoplectic, and those where it is pale, anemic, in syncope.

1st. *The Infant is blue, apoplectic.* — The first thing to do is to remove immediately every obstacle to respiration. The infant is placed on its back, the head resting on a pillow, and by means of a finger, or a feather, the nostrils and the pharynx are cleansed of obstructing mucus. Now cutting the cord, allow it to bleed until the infant has lost one to two teaspoonsful of blood. If the blood do not flow readily, before tying the cord place the infant for a few minutes in a hot bath. The blood soon flows: the cord is tied, the infant wrapped in hot cloths, and rubbed vigorously. The cyanotic tint, ordinarily, disappears rapidly, to give place to the normal, and a few frictions, slapping of the feet, or a second bath, causes the child to respire more or less freely. If this does not suffice, we must proceed to artificial respiration or insufflation.

If the infant be anemic, we must have care that it does not lose the least quantity of blood. On the contrary, we must tie the cord at once and with care, plunge it alternately in a hot and then in a cold bath, pour cold water from a height on the epigastrium, whip it with a wet cloth, tickle the nostrils with a feather, and, if this does not suffice, quickly resort to artificial respiration.

It is our belief that insufflation is a much more efficacious means, but there are a number of other measures which are of value. For instance, the following procedure has often served us well. The infant, wrapped in hot cloths, and its head on a pillow, is placed on its back with the arms alongside the body. Seizing each arm, they are quickly lifted towards the head, and then rapidly pressed down against the thorax. These movements, repeated alternately, dilate the thorax, and thus assist the entrance of air into the lungs. Marshall Hall's method is warmly recommended by Naegelé, Grenser and Spiegelberg. Schultze endorses the following methods: "The accoucheur, standing with the body slightly bent forward, the legs moderately separated, the arms extended towards the ground, seizes the infant by the index fingers passed from behind forward into the axillæ. (Figs. 246, 247.) The thumbs rest gently over the clavicles, and the remaining fingers are applied against the posterior surface of the clavicle, in the direction from above downwards. The infant's head is supported against the wrists. This position is that of inspiration. The accoucheur, thus holding it, suddenly throws the infant forward and upward. When the accoucheur's arms are a trifle above the horizontal line, the motion is gently stopped, so as not to jerk the child, and the fœtal lumbar spine is flexed, the abdomen being forcibly compressed by the weight of the pelvic extremity. The result of this passive expiratory movement, is an abundant flow of mucous from the respiratory passages. The position of the child is now gently changed to that which it occupied at the outset, and the thorax, freed from all pressure, enlarges by its own elasticity, and the diaphragm sinks with the retreat of the pelvic viscera. Thus, by a purely passive process, is produced a deep inspiration. After a few seconds, the manœuvres are repeated. The air enters the glottis audibly. When spontaneous effort at respiration is made, the above method is to be desisted from, in order that the spontaneous respiratory process may not be interfered with by the artificial."

Boer, Desormeaux, Stoltz, and others, advise recourse to electricity, in the shape of galvanism, or electro-puncture. Leroy has been able, by passing a galvanic current through the diaphragm, to produce in animals asphyxiated by drowning alternate contraction and relaxation of this muscle, and to provoke, finally, the return of respiration, and of life. Lauth, finally, has advised the use of the induced current.

These methods, we believe, to be all of less value than insufflation. According to Depaul, insufflation has been practised, in case of asphyxia, from great antiquity. It has been condemned by, among others, Duméril, Leroy D'Étiolles, Piorry. In 1845, Depaul published his first paper on this subject, and, since then, he has not seen fit to modify in the least his conclusions in regard to the usefulness of insufflation, but still holds that the procedure, when properly performed, is not only advantageous, but absolutely harmless.

Method of Performing Insufflation.—The oldest and simplest method is that from mouth to mouth. It was Pia who first proposed a tube, one end of which was to be introduced into the mouth, and the other blown through. Chaussier first devised a laryngeal tube, as perfect as possible, and which has been slightly modified by Depaul.

Chaussier's tube is conical, made of metal, about eight inches long, slightly flattened on the sides. The larger end, A (Fig. 248) is rounded and flanged, that the lips may be readily applied. The other end, B, is flattened, and is perforated at C. The tube is curved for ready introduction into the larynx. Where the curvature of the tube begins, is a transverse depression, into which is fitted a sponge. This instrument, then, adapts itself perfectly to the larynx, closes the glottis, so that the insufflated air cannot readily escape, but must dilate the lungs. Depaul has replaced the lateral openings by a terminal, thus facilitating the entrance of air into the bronchi. He thus describes the manner of using the tube. "The body of the infant should be kept warm constantly. It lies on a pillow, so that the head is higher than the pelvis, and the anterior surface of the neck should project a trifle. Of course all mucus has been removed from the mouth and the pharynx. The tube is guided by the finger into the larynx, care being taken not to pass it into the œsophagus. In order to be certain that the tube is in the larynx, feel for it externally. On making the insufflations, to be certain that the air enters the trachea, the lips are to be compressed around the tube, and the nostrils closed." We must blow into the tube with some force, and need not fear rupture of the pulmonary vesicles, or emphysema, since the lungs offer considerable resistance. Ten to fifteen insufflations a minute are sufficient, and we reinstate expiration by pressure applied by the hands to the thoracic walls. The air issues from the tube, audibly. It is well to withdraw the tube from time to time, in order to cleanse it. When the insufflated air bubbles as it enters the tube, we know that there is something in it. We, therefore, first aspirate, and then remove the tube. This process of insufflation should be continued for a variable time, sometimes an hour, or more.

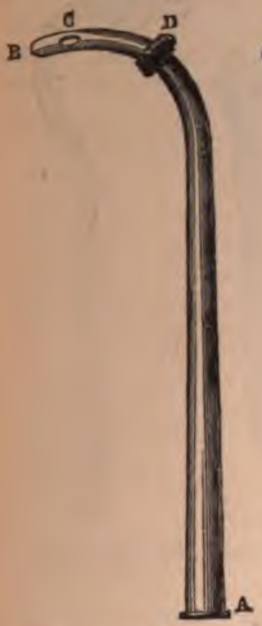


FIG. 248.—CHAUSSIER'S TUBE.

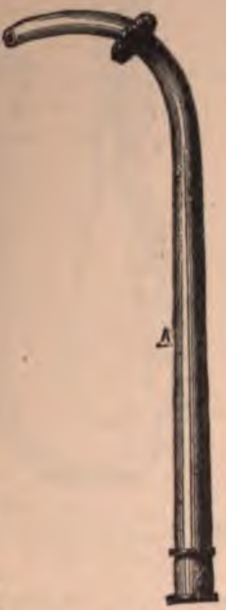


FIG. 249.—DEPAUL'S TUBE.

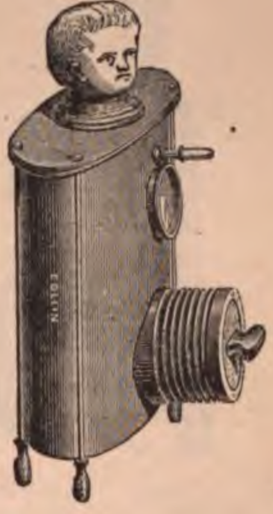


FIG. 250.—WOILLEZ'S SPIROPHORE.

The first result of insufflation is to make the heart-beat precise, strong, and more frequent. The skin of the face, and of the chest, regains its natural tint, then the nostrils move slightly, and at the base of the thorax are noted a few contractions of the diaphragm. Finally the child makes its first spontaneous respiratory act. At first incomplete, and at long intervals, these inspiratory acts become, at length, more regular and deeper, but they are separated by incomplete inspirations. Now, ceasing insufflation for the moment, the infant is plunged into a hot bath, whipped, etc., insufflation is resumed, and, at the end of a few minutes, the child regains its color more and more, opens its eyes, inspirations become normal, it cries, and its life has been saved.

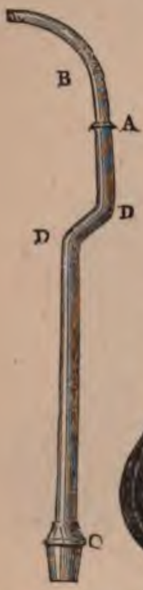


FIG. 251.—GAIRAL'S ÆROPHORE.

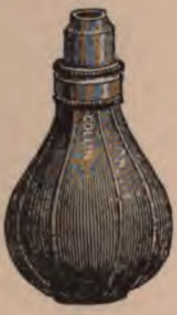


FIG. 252.—RUBBER INSUFFLATOR.

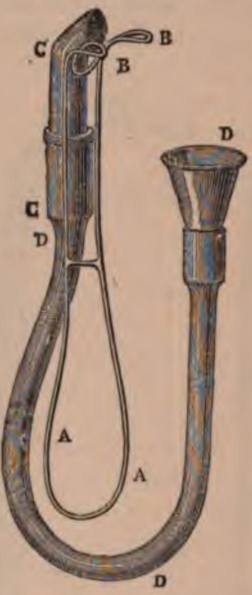


FIG. 253.—PROS DE LA ROCHELLE'S INSUFFLATOR.

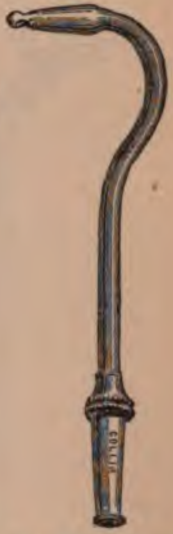


FIG. 254.—RIBEMONT'S LARYNGEAL TUBE.

At times, however, the inspirations remain incomplete, tremulous, separated by irregular intervals. The child breathes badly, cries badly, and dies at the end of a few hours. By means of insufflation the heart-beat may be maintained for a number of hours, but normal respiration never becomes established.

For a number of years efforts have been made to improve on this method of pulmonary insufflation. In 1875 Woillez invented the spirophore (Fig. 250), and Depaul tried it ten times with nine failures. In 1876, Gairal devised the ærophore (Figs. 251, 252), and in 1877 Pros an insufflator (Fig. 253). In the latter year, Ribemont devised a new laryngeal tube (Fig. 254), which, according to him, has the following advantages: 1st. Easier of introduction, on account of its anatomical curve, and because of the knob at the end. 2d. The ease with which, by means of it, we may remove mucus from the larynx. Depaul shows that this tube is not a good one for the following reasons: 1st. Its curvature has been derived from the larynx of a cadaver, which differs markedly from that of the living infant. 2d. Its introduction is no easier than that of Chaussier. 3d. That aspiration through his own tube is far easier, for the reason that the opening is terminal. 4th. Finally, Ribemont's tube, as proven by almost the first case where it was used, may produce emphysema.

CHAPTER XIX.

THE NORMAL PUERPERIUM.

BY the term puerperium, we mean the period which elapses between the expulsion of the placenta and the return of the genital organs to the normal state. We say normal state, but only in a relative sense. We have already seen that the uterus, after the first confinement, remains a trifle larger than before conception. The end of the process of involution is not fixed, and although, in general, it may be said to be completed about the sixtieth or seventieth day after delivery, there are many women in whom much more time is requisite. There exists, however, one sign, which, if it does not mark the end of involution, indicates at least the return of a prime function of woman, and this is the reappearance of the menses, the external manifestation of renewed ovulation, in other words the sign which tells us that the ovary has resumed its *rôle* in the economy. We believe that this sign indicates the end of the puerperal state. It is during this period that the hypertrophy, characteristic of pregnancy, is replaced by the tendency to atrophy which predominates during the puerperium. This atrophy, this retrograde metamorphosis, concerns all the systems of the body, but, in particular, the genital organs, since they have suffered the greatest alteration by reason of pregnancy. Often this retrogression occurs in a physiological manner, so to speak, without interfering with the health of the woman; in other instances, however, what are called puerperal accidents interfere with involution, and the woman's health is more or less compromised. Whence the two divisions, physiological puerperium, and pathological. In this chapter we are concerned with the former, and we refer the reader to the end of this work for the study of the pathology of the puerperal state.

There are two kinds of phenomena: 1st. General phenomena. 2d. Local phenomena.

1st. General Phenomena.

The first phenomenon following on delivery is a feeling of lassitude, of fatigue, which must be satisfied by the most complete rest. Peaceful, and smiling, the woman, happy in her safety, shows her joy by her actions and her words; or else, she seems tired out by her labors, resting perfectly impassive; or else, finally, she is covered with perspiration, her skin is hot, and she is still excited by the last efforts of labor. Almost all primiparæ complain that their genital organs feel as though ruptured, and the coccygeal region contused. After the lapse of a few hours, these painful sensations, the result of the pressure exercised by the head on these organs, disappear, although, at times, the pain over the coccyx remains for a number of days. We have already referred to the chill following delivery. It is of no serious import, and all that is needed is extra bed-clothes, and a hot drink. Usually the woman goes to sleep, during which she perspires freely, and, on awakening, she is hungry, and naturally so, seeing that she has fasted during the hours of labor.

The abdomen is relaxed, not painful; the uterus, well contracted, is about the level of the umbilicus, spherical, and a trifle sensitive on palpation. If, as should be the rule, the physician visits the newly-delivered woman in from five to six hours after labor, he will find that the uterus is higher, often greatly so, than the umbilicus, and yet the woman does not complain, nor is there danger of hemorrhage. This phenomenon, more frequent in primiparæ than in multiparæ, is due to the fact that the woman has not urinated, and that the uterus, therefore, is pushed up by the distended bladder. This organ emptied, the uterus will return to the proper position.

It has been pointed out by Naegelé and Grenser, that owing to the vast quantity of blood which has flowed to the uterus, and which has only partially escaped from the uterine sinuses, there exists a species of general plethora, for the disappearance of which derivation is necessary, and this takes place through the skin, the breasts, and the lochial flow. This, in especial, is the reason for the abundant perspiration, sour in smell, which occurs a number of times daily, in particular during sleep, and is accompanied, frequently, by miliary, scarlatiniform, eruptions. These eruptions should not be confounded with true scarlatina, for they are insignificant, and not at all of bad omen.

Weight.—This increase in secretion entails diminution in body-weight. Those women who were fat, and bloated, return to the normal state, and sometimes alter so much in a few days that they are scarcely recognizable.

Gassner has studied the variations in weight during pregnancy, labor, and the puerperium, and he has reached the following conclusions:

A. *Pregnancy.*—During the last three months of pregnancy, the maternal body gains at least one-thirteenth of the total body-weight. This increase is proportionately less in primiparæ than in multiparæ.

B. *Labor.*—After labor the woman has lost one-ninth part of the body-weight of a gravid woman at the tenth lunar month of pregnancy. This is, above all, the result of the expulsion of the fœtus and its annexes, of the loss of blood during delivery, as well as the loss of fæcal matter, and the excretions of the lungs and skin. Primiparæ lose less than multiparæ.

C. *Puerperium.*—1. During the eight days which follow labor the woman loses one-eighth of her body-weight. 2. This loss is the greater the nearer delivery to term. 3. Primiparæ, and women who do not nurse, lose less than multiparæ, and those who do nurse. 4. This loss is in direct proportion to the total body-weight of the puerpera. 5. During the same interval the amount of lochia from women who do not nurse is far greater than from those who do. 6. The greater loss of weight occurring during the first few days is due to the increase in the secretion from the kidneys, to the abundance of lochia, and to the excessive perspiration.

D. *Total loss due to labor and puerperium.*—The mean loss amounts to about one-fifth of the total body-weight at term.

E. Usually, at the end of six or seven weeks the loss sustained is regained; nevertheless, so many conditions may interfere with or favor normal nutrition, that we can only state approximately the time when this return to the normal occurs.

Temperature. — Wunderlich, Gruber, Hecker, Grunewaldt, Winckel, Schroeder, have made a number of interesting experiments in regard to temperature during the puerperium. Hecker has found that: 1. In many cases the temperature of the body rises markedly after labor—from 98.5° to 102°, the normal temperature being 98.2°. The temperature appears to rise the higher where the pains have been very intense. 2. At the beginning of the puerperal state the temperature is frequently lowered. The lowest range is seen twenty-four hours after delivery. 3. During the twenty-four hours after delivery, the temperature may exceed the normal by three and a half degrees, without the woman being sick. 4. In general, the pulse rises with the temperature; often, moreover, the pulse is quicker and the temperature does not alter. 5. At about the ninth day, the temperature frequently falls below the normal. This has been called the stage of inanition.

Schroeder gives us the following figures:

Temperature during Labor.

	Mean.
From 8 o'clock to midnight,	98.4° in 39 cases.
" midnight " 5.30 A.M.	98.3 " 11 "
" 5.30 A.M. " 11.30 A.M.	98.3 " 50 "
" 11.30 A.M. " 3.30 P.M.	98.3 " 18 "
" 3.30 P.M. " 8 P.M.	98.1 " 52 "

Temperature during Puerperium.

One hour before labor	98.4° in 12 cases.
1 to 3 hours after labor	98.25 " 31 "
3 " 5 " " "	100.02 " 26 "
5 " 10 " " "	98.4 " 26 "
10 " 20 " " "	98.3 " 24 "
20 " 30 " " "	98.3 " 21 "
30 " 50 " " "	98.3 " 14 "
50 and over " "	98.2 " 7 "

Wolf gives the same figures as Schroeder, and finds that when lactation becomes established, there is a slight elevation of temperature, about 0.5 of a degree. In agreement with Schroeder he finds that, at this time, the mean temperature is 100.2°. This figure, as we will see, is about the same as that given by Chantreuil in his monograph on lactation. Grunewaldt believes this figure too low, and places it at 101°. Winckel, in 1878, analyzing his own observations made in 1861, in connection with those we have just noted, states it as an established fact, that, during the first twelve hours after labor, there is generally a slight elevation of temperature, but little above the normal; during the twelve following hours, generally a slight fall in temperature. Whilst this elevation is especially noted when it coincides with the normal evening rise, it may easily escape our notice, if, labor occurring at night, the temperature is taken the following morning.

After this fall in temperature, at the end of the first twenty-four hours, it begins to rise again. The evening temperature is usually higher than that of the morning; the diurnal oscillations are slight. Usually, this elevation of temperature accompanies the secretion of milk, diminishing when this function is regularly established, or when it is in abeyance as in women who do not nurse.

The temperature of the healthy puerpera ranges to the same degree as during ordinary health, although the mean temperature during the puerperium remains slightly higher than under normal conditions.

Respiration and Pulmonary Capacity.

Winckel, who believes the normal respiratory rate to be 16 or 18 the minute, has found during the first fourteen days, in 16 cases, 16 respirations, in 1 case 17, and in 6 cases 18 respirations per minute. Wild Sims finds a higher mean, 23 respirations. According to him, the capacity of the lungs, in general, augments after labor, although often it does not change, and at times even diminishes.

Dohrn, who has directly measured the pulmonary capacity, has found: in 60 per cent. of cases, augmentation to 131.8 cubic inches; in 26 per cent. 8.6 cubic inches; in 14 per cent. no change.

In primiparæ this increase is less than in multiparæ. These results are opposed to those of Wintrich, of Kuchenmeister, of Fabius, who have found that the lung capacity after labor was equal to or below that before labor. The experiments of Reinhard confirm those of Dohrn.

Circulation.—Blot, Naegelé and Grenser, Bouchacourt, Marey, Fritsch, Winckel, and others, have specially studied the modifications of the circulation, and all are agreed on this point "that the blood, and the modifications in the organs of circulation, are in intimate connection with the increase in pulmonary activity. The blood, rich in fibrin, takes up in the lungs a greater quantity of oxygen than it could retain during the last few months of gestation. This blood, rich in fibrin, and surcharged with oxygen, excites the heart and the arteries to contract with energy: whence results the fact that during the first few days, the woman's pulse is fuller and harder. Again, the thoracic and abdominal organs, which had been displaced during pregnancy, return to their normal position. Therefore the circulation becomes freer and more energetic: for the same reason the œdematous conditions of pregnancy rapidly disappear during the puerperium, and the varices, developed during pregnancy, diminish notably, if not altogether." (Naegelé and Grenser.)

Another phenomenon has been noted by Stoltz, and carefully studied by Blot in 1863, and this is the slowing of the pulse. More or less accentuated in healthy puerperæ, this slowing is all the more marked the better the state of the body-health. The pulse-rate may fall to 35 per minute, and it oscillates between 44 and 60. More rapid in multiparæ than in primiparæ, the slowing may last for a few hours to fifteen or twenty days. It begins, ordinarily, within the twenty-four hours following labor, augments, remains stationary, and little by little disappears. It may even persist during lactation: it is independent of the duration of labor, but is under the influence of the least pathological change; it is observed after miscarriage, and premature labor, as well as after normal labor, and the most intense uterine contractions do not cause it to disappear. Abundant hemorrhage influences it: the position of the woman causes notable variation: it is a most valuable prognostic sign, for it is met with only in healthy puerperæ.

The above conclusions of Blot have been confirmed by Falischi of Sienna, by Winckel, Baumfelder and Gruber. The latter compares the pulse of the puerpera to that met with on the sound side of hemiplegics: the pulse of the healthy woman is anacrotic, in febrile states it becomes dicrotic.

Digestion.—During the early puerperal days the function of digestion is poorly performed. The appetite is slight; the thirst, however, is increased, constipation is the rule, partly because during labor the fæcal matter has been evacuated either spontaneously, or by enema; partly, because the woman eats but little; partly because the peristaltic contractions of the intestine are lacking in power, and therefore the fæcal matter travels slowly; partly, finally, because the relaxed abdominal muscles cannot assist in the expulsion of the accumulation in the rectum.

Urinary function.—This has been studied, in particular, by Gassner, Winckel, Kleinwachter, Fritsch, Klemmer, Schroeder.

Gassner showed, at the outset, that the amount of urine is notably increased, (he mentions the case of a woman, who, suffering from considerable œdema, passed, in the forty-two hours after labor, twenty-two pounds of urine), and that this increase is manifest even in women who are not œdematous. According to Winckel, there is an increase during the first days of the puerperium, in particular the first forty-eight hours. The urine is clear, without deposit, of a low specific gravity. The absolute amount of urea, phosphates, and sulphates, is a trifle less; that of the chlorides remains about the same. As the condition of the genital organs returns to the normal, the quantity of urine diminishes, the specific gravity approaches the normal, the color becomes yellow, and the urea, etc., reach the mean standard figure. An important point is that the excretion of the contents of the urine follows the temperature curve. The mean amount of urine excreted by a healthy puerpera during the first six days is 350 ounces, the specific weight is 1.010. It is not unusual to find a little albumin in this urine, and, further, Blot, Kirsten, Brucke, Ivanoff, and Hempel, have detected sugar. Spiegelberg and Hempel explain the presence of sugar by resorption from the milk. The increase in the secretion from the kidney is intended chiefly to remove from the organism a large amount of water, but we must believe as well that the products of oxidation are thus, in part, eliminated.

Kleinwachter and Fritsch, in opposition to Winckel, believe that the amount of urine excreted is in proportion to the amount of food ingested. In women who are amply nourished, the quantity of urine is only altered during the first day, when it increases, and then diminishes a trifle the next few days, to increase again a little at the expiration of the puerperium.

Klemmer, on the contrary, confirms the conclusions of Winckel. Notwithstanding food ingested of a very nourishing nature, he has found the mean quantity, during the first few days, to be 63.4 ounces and the specific weight 1.019.

It is not unusual for twelve and even twenty-four hours to elapse before the first micturition. We have already mentioned how such distension of the bladder will elevate the uterus, and how, further, it may be at the bottom of colic and after-pains. Of course, the physician should not allow this distension to occur, but if, at the first visit after delivery, six to eight hours after, urine be found in the bladder, and the patient is unable to pass it, then, if hot applications over the bladder fail in assisting her, the catheter should at once be introduced. In regard to emptying the bladder, we must not believe the statement of the woman that she has done so, but we must assure ourselves by the height of the uterus, and gentle percussion, that this organ is empty. This inability to pass urine ordinarily passes away at the end of twenty-four hours; at times, however, it persists for three to eight, and, even as in one personal case, to eighteen days. The causes are varied: Certain women cannot pass urine in the dorsal decubitus; at other times the abdominal muscles are weakened by the rapidity or prolongation of labor, and, hence, cannot assist the bladder; again it is the result of the pressure which the fœtal head exercised on the neck of the bladder, or on the urethra, and the resulting swelling of this canal, or a transient paralysis of the entire organ. Mattei and Olshausen would find an explanation in the exaggerated curve of the urethra; Schroeder points out, justly, that there exists not only impossibility to urinate, but absence of desire as well.

The Nervous System.—This is notably excited. Even the healthy puerpera is very impressionable. We will see, further on, that grave nervous and psychic diseases may develop, and compromise the health of the woman, (puerperal mania, chorea, etc.)

LOCAL PHENOMENA—INVOLUTION OF THE GENITAL ORGANS—THE LOCHIA—LACTATION.

With the diminution in size of the abdomen which follows delivery, the abdominal walls relax to such an extent, that it is possible to press the fingers deeply into the abdominal cavity, and to palpate readily, not only the fundus, and the posterior wall of the uterus, but also the spinal column, the aorta, the bladder, and the rectum. Only at the end of a few weeks, at times many months, do the abdominal walls regain their contractility and normal thickness, but the *linea alba*, and the umbilical ring, remain so much enlarged, that, in certain women, hernia results. The skin may remain loose, and hang like a bag over the pubes; at times, on the other hand, the abdomen remains larger from development of fat in the omentum and in the abdominal walls. These last phenomena are most likely in lymphatic blondes, who already had a tendency to embonpoint. To the despair of these women, the physician cannot assist them. Abdominal bandages alone aid them, by concealing, rather than by causing, the disappearance of this fat.

Modifications of the Genital Organs.—More time is requisite than is usually believed for the return of the vulva, perineum, and the vagina, to the normal. If the perineum be intact, the fourchette alone ruptured, cicatrization rapidly sets in, and without leaving much trace. In case of rupture of the perineum, two things, as we will see, may occur. It is however, particularly the vulvo-vaginal lesions which are of frequent occurrence in primiparæ, and which require a long time for cicatrization. Frequently, for a few days, œdema of one or another labium minus is present. If, in such event, we separate the vulvar cleft, we find in addition to fissures and erosions a species of necrotic patch, of greater or less extent, situated to the side of the swelling, a patch which separates at the end of a few days, and gives place to an open wound, which requires from twelve to fifteen days to cicatrize. The same thing happens to those incisions which we may have been obliged to make in order to avoid laceration of the perineum. (See, in this connection, chapter on "Laceration of the Perineum.")

These lesions of the vaginal orifice have been studied by many authors, amongst whom we mention Thiaudière and Budin. "At the first labor,

the ostium vaginæ is always torn. The lacerations are generally multiple —one in the mid-line posteriorly, and one or more to the left and to the right. The posterior and median laceration, during the expulsion of the head, may extend into the mucous membrane of the vagina, at the navicular fossa, and be the starting point of perineal laceration; but this median and posterior tear is not constant. After labor, the appearance of the vaginal orifice is completely altered; the hymen has been more or less destroyed; the vulvar cleft is continuous with the vaginal canal; the carunculæ myrtiformes are present, being the remains of the anterior extremity of the vagina. These lesions of the orifice may extend into the mucous membrane of the vagina. When cicatrization occurs, the tissues which surround the vaginal orifice retract.” The vagina is frequently, at its upper part, dilated, and presents, according to Bouchacourt, the form of a pouch, and this he considers characterisic of recent delivery.

The broad ligaments return to their normal shape. The two divisions of these ligaments come together again, and the tubes and the ovaries resume their natural position in the pelvis, in case they have not, as the result of an inflammatory process, formed adhesions to the neighboring organs.

Involution of the Uterus.—We have seen that, during pregnancy, the uterus undergoes modifications in form, volume, consistency, situation, direction, and structure. These phenomena must retrograde, during the puerperium, in order that the uterus may return to the normal. Whence a series of modifications which we will pass successively in review. These modifications concern both the cervix and the body, but they are far more difficult to follow in the body, since, at the end of a few days, it returns to the pelvic cavity, and escapes, so to speak, our investigations. Still to a degree, as will be seen, we may follow the changes in the body of the uterus. This organ tends to resume its original shape and situation, but it does this slowly and progressively. Schroeder, Winckel, Veit, Horwitz, Martin, and Bidder, have, in particular, studied this question.

Bidder, whose observations concern more especially the changes in form and in situation of the uterus, shows that flexions and versions are very frequent during the puerperium.

The following table gives the percentages found by Horwitz, Winckel, Schroeder, and Bidder:

	Anteversion.	Anteflexion.	Retroversion.	Retroflexion.	Normal.
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Bidder in 286 cases,	20.2	46.5	1.4		31.8
Horwitz “ 300 “	11.3	17.3	9.3	5.3	56.7
Winckel “ 100 “	20.	21.	6.		53.
Schroeder“ 214 “	.46	71.		1.8	26.6

These deviations do not depend directly on labor, but usually on an inflammation or hypertrophy of the uterus during pregnancy. We understand readily, therefore, how these deviations may persist after labor, and become the cause of further disease.

Let us see now what the modifications are which the uterus undergoes after labor, and how the organ returns to the normal. These modifications have received the name of involution. Immediately after the birth of the fœtus the uterus retracts, its body becomes more consistent, its form more spherical, but the cervix does not close at once, and the finger in the vagina determines that the cervix, soft and relaxed, floats, as it were, in the upper part of the vagina. The external os, widely open, may be distended with the greatest ease. The internal os has partially closed, but it is soft, dilatable, and the resistance it offers is insignificant.

The placenta once delivered, the cervix becomes firmer and more resisting. Its length has diminished notably, although beyond the normal, and it is still permeable to the finger. At the end of a few hours, the cervix has acquired more tonicity; in appearance it is more normal, the internal os is closed—whence the difficulty sometimes met with when it is necessary to extract a retained placenta. This difficulty is as nothing, in general, compared to that resulting from placental adhesions, but it is still a serious matter. At the end of two or three days, the cervix has usually regained its shape. During the few days after delivery, the external os is gaping, the cervical canal, in both primiparæ and multiparæ, allows the passage of the finger to the internal os, which is open, but difficult to pass. The lips of the cervix are swollen, unequal, and soft, easily depressed, and bleeding at the touch of the finger. From this time forth, the cervix progressively resumes its shape, consistency, and original dimensions.

We have had occasion, as is noted further on, to examine eighty-three women with the speculum, about fourteen days after delivery, and we have been struck by the difference existing between primiparæ and multiparæ as regards the changes in the cervix. We do not speak of the outside of the cervix, because, although we have attempted to measure the exterior of the vaginal portion, we have not been able to obtain any reliable results.

When the speculum is inserted into the vagina of a woman delivered about fifteen days previously, the first thing noticed is that its color is more or less deepened, that it is as yet more or less relaxed, and, at the bottom, and issuing from the cervix there is mucus, colored dirty brown, at times as much as a teaspoonful. When this mucus is wiped off with cotton, the cervix is seen. In multiparæ it is bluer, firmer, and more compact than in primiparæ, and does not seem so narrow. In primiparæ, on the other hand, the cervix is larger, softer, and bleeds more readily to the touch, but what is particularly noteworthy is the external os. It is larger than in multiparæ, light red, and granular, the lips projecting considerably, and the mucus membrane, protruding, forms a true ectropion, which Nieberding so well described in 1879, an ectropion which tends to disappear during the puerperium, but which we may find traces of even at the return of menstruation.

At the thirtieth or fortieth day, the cervix has usually regained its normal length, although it is still much larger. The lips are more distinct, less relaxed. We do not, hence, agree with Depaul in the statement that in multiparæ the cervix returns less rapidly to the normal, and that it remains longer soft and permeable. We believe that Depaul thought so because he only made a digital examination, and that the multiparous cervix, being shorter than the primiparous, is more depressible and easier to pass. However, Depaul himself admits that there are many variations, and he attributes to ergot a marked effect in the retrogression of the cervix.

Milsom has endeavored to measure the length of the cervix by means of the hysterometer, and, taking Bandl's ring as the upper limit, gives the following figures:

4th day	10 cases	3.1 inches to external os.
5th "	4 "	3.1 " " " "
6th "	6 "	2.7 " " " "
7th "	8 "	2.6 " " " "
11th "	12 "	2.5 " " " "

These figures seem to us very excessive when compared with those obtained, about the twelfth and the fourteenth day, from measurements of the uterine cavity. The hysterometer, indeed, gives the dimensions of the uterus, body and cervix together, and it is difficult to make correct allowance for each. Finally, the figures obtained by Milsom for the body of the uterus, and those given further on, from our own and Sinclair's researches, cannot be accepted with those given above for the cervix.

As for the body of the uterus, the modifications are more difficult to appreciate, and, notwithstanding every care, we can do so only approximately. The weight of the uterus is given by Simpson as 23.56 ounces, by Naegelé 23.5 to 24 ounces, by Heschl and Playfair, 20.3 to 20.4 ounces, by Spiegelberg 31.24 ounces, and this diminishes rapidly after labor. According to the last authority, the weight is only 23.5 ounces two days after labor, about 16 ounces at the end of the first week, 12 ounces at the end of the second, and at the end of the sixth the uterus has returned nearly to the normal; for the uterus which has borne one child remains ever a little heavier, a little larger, with more spacious cavity than in the virginal state. This is readily apparent from the figures given in the anatomical part of this work.

The dimensions of the uterus suffer the same reduction. At the end of pregnancy the organ has a mean vertical diameter of 12 to 14 inches, antero-posterior diameter of 8 to 9, transverse of 9 to 10, and, after labor, these diameters diminish slowly to the normal. This diminution is not due alone to the retreat of the organ, but to involution, a complete transformation of all its constituent elements.

Endeavors have been made to follow this work which takes place in the uterus, and while some have measured the organ, others, envisaging the subject more closely, have studied with the microscope the phenomena of involution. Wieland was the first to measure directly the progress of involution, but the figures he obtained are far below those of others. He gives the vertical dimensions of the uterus as 5 to 5.4 inches, and the transverse as 3.5 to 3.9, immediately after the expulsion of clots and of placenta. But his measurements concern only that portion of the uterus which is above the pubes, and consequently, differ widely from the true dimensions of the organ. Bouchacourt, and his pupils, Philipotaux, Mardual and Morin, conclude, from 100 observations, that: "At the end of the first, or the commencement of the second day after labor, the fundus of the uterus rises about .7 inches, to descend .39 to .7 inches daily, with slight re-ascent on the fifth day, a stationary period on the seventh day." The descent of the uterus, therefore, is more or less regular, at the rate of .39 to .7 inches daily.

Autefage, whose experiments were conducted and controlled by ourselves and by Depaul, used Baudelocque's pelvimeter, modified by Depaul. One branch was introduced into the vagina, and held by the finger against the cervix, at the level of the external os, the other was applied at the fundus of the uterus. Thus the vertical diameter was obtained. The transverse diameter was taken through the abdominal wall, at the largest part of the uterus. The following are the figures he obtained, and they were controlled by myself:

42 women, six hours after delivery: vertical diameter 6.2 inches (mean); from pubes to fundus uteri 4.3 inches (mean); transverse diameter 4.7 inches (mean.)

16 women, six to twelve hours after delivery: vertical diameter 6.4 inches (mean); from pubes to fundus uteri 4.8 inches (mean); transverse diameter 4.8 inches (mean.)

7 women, from twelve to eighteen hours after: vertical diameter 6.4 inches (mean); from pubes to fundus uteri 5.4 inches (mean); transverse diameter 5 inches (mean.)

19 women, from eighteen to twenty-four hours after: vertical diameter 6.3 inches (mean); from pubes to fundus uteri 4.5 inches (mean); transverse diameter (mean.)

The measurements taken thereafter daily, the rectum and the bladder having first been emptied, have given the figures in the annexed table. These figures are exact, and my personal researches have confirmed them. The regularity is not as complete, however, as may be thought from a study of the table, for I have frequently found, and without pathological cause, that involution might cease for a day, the uterus even increasing a trifle in size, to decrease again, finally sinking into the pelvis about the tenth or twelfth day.

TABLE SHOWING DECREASE IN UTERUS, DURING 12 DAYS AFTER LABOR.
[CONDENSED—ED.]

Days.	Mean height.	Mean height from pubes to fundus.	Size of body.	Mean situation of umbilicus.
1.	6.3	4.8	4.8	5 inches above the pubes.
2.	5.8	4.2	4.5	
3.	5.5	3.9	4.5	5.4 inches below ensiform cartilage.
4.	5.2	3.5	3.9	
5.	4.8	3.1	3.7	
6.	4.5	2.5	3.3	
7.	4.4	2.3	3.1	
8.	4.	2.1	2.9	
9.	3.7	1.7	2.5	
10.	3.3	1.3		
11.	2.9	.9		
12.	2.9			

I have further found, in agreement with Autefage and Depaul, that involution occurs more rapidly in primiparæ than in multiparæ, and I further admit the manifest influence of ergot administered after delivery. I cannot express myself as positively in regard to the influence of lactation. It has seemed to me to interfere with involution, but my observations have been made in a hospital where each woman is obliged to nurse her infant. Nevertheless, comparative observations, but incomplete because made on private patients who will not submit to careful experiment, incline me to agree with those who believe that lactation interferes with involution. Pinard, my colleague, is of the contrary opinion, but my teacher, Depaul, agrees with me.

[In reference to this point, one would, *á priori*, be led to the belief that lactation assists uterine involution. It is a familiar fact that the application of the infant to the breast causes uterine contractions, painful to the mother, and we can recall one case where this effect was constant for the first ten days after delivery. Contractions of the uterus not only empty it of clots, but also make the organ less congested, more bloodless. Further, the sympathy between the uterus and mammæ is so close, that it is allowable to think that congestion of the one, excessive function of the one, may have a derivative action on the other. The milk markedly diminishes where the lochia become profuse or last over long; while in our experience, other factors equal, the lochial flow is more natural in women who nurse, or have an abundance of milk, than in those who do not. We believe, therefore, that the proper performance of lactation assists involution through a species of derivative effect on the uterus. Careful comparative experiments are, however, necessary to settle this point.—Ed.]

Whatever the precautions, external measurements cannot give us exact figures. During the year 1880, while substituting for Depaul at the *Clinique d'Accouchements*, I endeavored to determine the exact dimensions of the uterus, by measuring the depth of the cavity of every woman before she left the hospital, about the fifteenth day after confinement. I thus examined 83 women. I believed I was the first to do this, when Budin called my attention to similar experiments made by Sinclair of Boston. My conclusions, as will be seen, are nearly similar to those of Sinclair. The only difference is that, having made his measurements on the seventeenth day, his figures are a trifle less than mine. My personal researches are contained in the thesis of my pupil, Dr. Avrard, published in December, 1880.

In 1881, Milsom, without being aware of either my experiments, or those of Sinclair, followed the same method with the hysterometer, the measurements being made about the tenth day. He has further made measurements from the thirtieth to the fiftieth day after delivery, thus determining, in a measure, the duration of involution.

[Charpentier here inserts the elaborate tables drawn up by Sinclair of Boston. Since our readers have ample access to the original, in the Transactions of the American Gynecological Society, Vols. for 1879, 1881, and to the continuation of these tables by Richardson, of the same city, in the volume of the same series for 1882, we omit them here, giving simply the comparative tables of Sinclair's and Charpentier's experiments.—Ed.]

The comparative length of the uterine cavity, in primiparæ and in multiparæ, as deduced from our own experiments and from Sinclair's, is:

MULTIPARÆ.

	Sinclair.		Charpentier.	
	No.	Length.	No.	Length.
From 8th to 10th day .	23	2.7 inches.	29	3.1 inches.
" 15th " 22d " .	5	3.1 "	9	3.1 "
" 22d " 30th " .	2	2.7 "		
" 30th " 40th " .			1	3.1 "
42d day			1	3.9 "
60th "			1	2.7 "
115th "			1	3.1 "

In the last four cases the puerperal state had been complicated by peritonitis, metritis, albuminuria. The last had required forceps for extraction of a child weighing eleven pounds.

PRIMIPARÆ.

	Sinclair.		Charpentier.	
	No.	Cavity.	No.	Cavity.
From 8th to 10th day .	50	2.7 inches.	23	3.1 inches
" 15th " 22d " .	17	2.7 "	12	3.1 "
" 22d " 30th " .	5	3.1 "	1	3.1 "
" 30th " 40th " .	4	2.7 "	1	4.3 "
" 40th " 50th " .	2	3.1		

According to Sinclair, therefore, the mean depth of the uterine cavity is 2.7 inches about the seventeenth day; for us, about 3.1 to 3.9 inches at the fourteenth day; we may hence conclude that, about the fourteenth day, the uterine depth is 3.5 inches, in at least half the women.

To resume the above figures:

Sinclair.		Charpentier.	
107 women, mean depth	2.3 to 4.6 in.	81 women, mean depth	2.3 to 4.6 in.
One woman only	1.9 " 2.3 "	One woman	5.07 in.

Our measurements were made after the following fashion: The woman was placed across the bed, the feet resting on two chairs, and the nates at the very edge of the bed. The lochial discharge had never ceased in any case. In multiparæ the genitals were more or less deeply colored, without lesion. In primiparæ, on the other hand, the vulva was nearly always eroded and the fouchette ruptured; in certain exceptional cases there were lacerations of the perineum; almost always there existed lesions of the mucous membrane and of the vaginal orifice, in a more or less advanced stage of cicatrization. And this was the case, as well in women who had been delivered spontaneously, as in those who had required instrumental interference. Cusco's speculum, introduced into the vagina, has always allowed us to examine the cervix carefully. In certain cases, above all in primiparæ, the introduction of the speculum caused the appearance of a drop of blood at the external os. The appearance of the cervix was very different, according as we were dealing with a primipara or a multipara. In the multipara, the cervix has always seemed less large. Its color was bluish, except at the level of the os, where there was a reddish circle, formed by the mucous membrane. Its consistency was firmer. In the primipara, the cervix, larger, has always, or nearly always, seemed inflamed, because the surroundings of the external os were red, projecting, as though granular, the mucous membrane of the lips being swollen, and bleeding at the least touch; in a word, it resembled that of a woman affected with deep granular ulceration of the cervix, looking, as expressed by Nieberding of Wurtzburg, like an ectropion. From this cervix, ordinarily, there flowed a greater or less quantity of bloody mucus.

The introduction of the hysterometer into the uterine cavity was only painful in a single instance. But, in a number of other instances, at the moment when the instrument passed the internal os, we saw appear at the external os, and out of the uterine cavity, a little blood mixed with mucus, as if the instrument, in opening the uterine cavity, had permitted it to empty itself of contained fluid. The color of the mucus proved that it had been retained for a certain time in the cavity. The uterus once emptied, the hysterometer passed to the fundus without giving pain. The woman simply knew when the point of the instrument touched the fundus, rather on account of a feeling of pressure than of one of pain. When the instrument had reached the fundus, the guard was pushed down to the cervix, the instrument withdrawn, and the number registered on the blade gave us the measurement of the uterine cavity.

In a number of instances, in primiparæ, and in particular where there existed a granular condition of the cervix, the withdrawal of the hysterometer has been followed by a slight bloody discharge; but this discharge has always been little, and has ceased in a few minutes, except in three or four cases where it lasted three or four hours. But even in these cases the examination in no wise injured the woman, for all those measured left the bed in a few hours without either pain or hemorrhage. Sinclair and Milsom never met with any accident following the use of the hysterometer.

[The experiments of Milsom in the same direction are tabulated here, but, since they agree in the main with those of Sinclair and of Charpentier, we omit them.—Ed.]

Finally, Milsom has studied the influence of the duration of labor, of miscarriage, and of premature delivery, and he admits that the duration of labor does not appear to have much influence on the progress of involution. It is established, however, that where labor has lasted less than twelve hours, involution is slightly quicker than where the act of labor has been longer; the daily diminution being 0.5 in the first instance, and 0.42 to 0.46 in the second.

As to the influence of premature labor at seven or eight months, it does not seem to be considerable. Involution, nevertheless, is a trifle retarded and it does not progress with such regularity.

As to the duration of involution, it is longer than is generally stated, and the experiments of Sinclair, of Milsom, and of ourselves, justify the statement that in women who do not nurse it requires a mean interval of seven to eight weeks, and from ten to twelve in those who do. We are speaking, of course, of cases where this involution has not been retarded by any pathological factor.

Involution is not accomplished after a similar fashion in primiparæ and in multiparæ. While in primiparæ it proceeds, as it were, insensibly, in multiparæ it is accompanied during the first few days by painful uterine contractions which are called after-pains. We cannot accept the opinion of Bouchacourt, who considers these pains absolutely independent of uterine retractility. Retractility and contractility, although they are special and independent properties of the uterus, are nevertheless conjoined, at least during the first twenty-four hours after delivery, and although the retractile property predominates, contractility still remains a factor during this period, and even longer in certain cases; and, while these contractions are painless in primiparæ, they are always the reverse in multiparæ, so painful that some women bear them less patiently than they do the pains of labor. They are, notwithstanding, of a similar nature—they are due to uterine contraction. They are painful, intermittent, accompanied by change of form and of consistency of the uterus, manifested by a hardening of this organ, and are excited by abdominal palpation, by lactation, etc. At first very intense, these pains assume a longer interval, diminishing in intensity, and cease, usually, at the end of twenty-four to thirty-six hours, although they may persist beyond this time. They should always be a source of solicitude to the physician, for although during the first thirty-six hours, their only importance is that of depriving the patient of rest, their existence beyond this period is often followed by pathological symptoms, (fever. metritis, pelvic peritonitis or cellulitis), and may, therefore, call for active treatment. They always yield to opium, either by the mouth, sprinkled on an abdominal poultice or by enema, twenty to thirty drops of the tincture, repeated in three to four hours.

[Since opium constipates, and not infrequently upsets the digestion, we much prefer, what is just as effective, chloral hydrate, by the mouth, fifteen grains repeated in one half hour, or by the rectum, in double the dose.—Ed.]

Now these after-pains being obviously due to uterine contractions, why are they painless in primiparæ, and the reverse in multiparæ? Depaul, who does not consider them as simply a continuation of the rythmical uterine contractions of labor, has noted that they are more intense in cases where labor has been easy than where it has been tedious, and that, during their presence, a slight amount of blood appears externally. In our opinion, after-pains are the result of nature's precautionary efforts to insure firm uterine contractions. If they exist to a less degree in the primipara, this is because in her retractility is perfect, present in all its intensity, and therefore contractility is not called for. On the other hand, they are present in the multipara, because the tone of the uterus has been enfeebled by a previous labor, and, retractility hence being less perfect, small clots can form in the uterine cavity, and these, being foreign bodies, excite the uterine muscular fibres, and determine contractions which are destined to expel such clots, and are so much the more painful, because the muscular walls having become thicker, the strength of the contractions is limited within narrower bounds. After-pains, then, are useless to the primipara, and she scarcely feels them; they are necessary to the welfare of the multipara, because the uterine fibre has been weakened by previous labor; uterine retractility is less perfect. .

Retractility and contractility, however, would not suffice to cause diminution in size of the uterus, if to these factors were not added the process of fatty degeneration which invades each anatomical element, and which causes the disappearance of certain of these elements, and their reproduction by new elements, and further causes diminution in size, acquired during pregnancy, of other elements; in a word, the process which substitutes normal conditions for the hypertrophic of gravidity. In one case, there is total destruction of old elements, and entire new formation; for others, there is not total destruction, but simple resorption of a part, and return to the normal, without new development. The theory of new-formation of muscular fibre has been championed by Kölliker, Heschl, Virchow, Aran and Sappey, while Robin, denying hypergenesis of uterine elements during pregnancy, and recognizing only their hypertrophy, denies total elemental destruction during involution.

Heschl maintains that the modifications invade all the anatomical elements, the peritoneum, the muscular tissue, the mucous membrane, the arteries and nerves, that the muscular tissue is entirely laid bare through the shedding of the decidua, except at the point of placental insertion and in the cervix, the mucous membrane of which, usually, remains intact with its hypertrophied papillæ, and its glands. Heschl, hence, is opposed in his views to Kilian, Robin, Arnold, Virchow, Duncan, Rolleston, Friedländer, Langhaus, and Leopold, who contend that the muscular coat is never laid bare, and that there always remains a portion of the old mucous membrane, which gives birth to the new mucous membrane through cell proliferation.

It is in the muscular tissue, and in the mucous membrane of the uterus, that the greatest changes occur. The substance of the uterus undergoes such a complete transformation into fat, that, according to Heschl, there does not remain a single one of the original cellular fibres of the uterus. Jenks is of the same opinion. This transformation begins about the fourth day, sometimes not until the sixth, never later than the eighth, and it extends regularly throughout the body, the cervix not partaking till later. Soon it is found that the degeneration is more marked in the internal than in the external layer. It begins in each of the muscular fibrils at many points together. These fibres lose their tortuous form, the borders become pale, and we perceive faint patches, which, since the extremities of the fibrils are thin, quickly isolate the fibrils. These patches remain apparent until masked by the globules of fat, which are constantly multiplying. Rapid absorption of this modified tissue now takes place, and this absorption is manifested by the diminution in size of the organs. As a result of this fatty degeneration, the uterus becomes more friable, and this persists until the return to the normal. The organ loses its red color, it assumes a reddish-yellow. At the fourth week, the first elements of the new uterine substance appear as follows: In the external layer appear cells, then fibrillar elements, which take on the shape of muscular fibres, and which are the new uterine substance. While the muscular substance of the organ is undergoing destruction, and becoming absorbed, the new tissue is everywhere developing, so that at the end of the second month, usually, the renovation is completed. The veins and the capillaries undergo a similar fatty degeneration. The point of placental insertion changes more slowly. Normally the veins are filled with thick clots, and project above the muscular tissue, between the muscular bundles which are undergoing degeneration; so that, at the end of the fourth or the sixth week, the point of placental insertion is still recognizable by the jutting out of the uterine tissue in this locality. Finally, the clots disappear, the veins become indistinct, the level is re-established, and the new mucous membrane covering all, the site of the placenta disappears, and is no longer recognizable. Nevertheless, for many months, there is a slight elevation at this site.

As for the mucous membrane, a few days after delivery this is carpeted by a reddish, soft, pulpy, floating substance. If the mucous membrane of the cervix be not affected, this substance is sharply outlined at the level of the internal os, spreads over the entire surface of the body, in thickness like a sheet of paper. Under the microscope, this substance is made up of pavement and cylindrical epithelial cells, and, in the layers nearest the new muscular coat, it consists of new fibrous tissue (tissue conjunctif). At the end of the third week the vessels reappear, sometimes even later. Until then the blood is apparently contained in trenches formed by the cells lying close together. The glands are renewed at the end of the second month. Heschl has not been able to follow their formation.

The above renewing of the uterus takes place similarly after miscarriage and twin labor, although in the latter case the process is less rapid.

According to Kilian, the nerves are neither destroyed nor replaced by new elements. The nerve cylinders, according to him, undergo a species of atrophy, of diminution in size, until another pregnancy determines fresh hypertrophy; even as in the remaining tissues of the uterus.

Ch. Robin admits that the uterine mucous membrane undergoes analogous and parallel changes to those which occur in the muscular walls and in the vessels. It falls away, and then regenerates into all the elements which composed it before labor. With Bischoff and Sharpey, he admits that the new mucous membrane is partially the result of development of tissue already existing, and partially a new formation. At the time of labor, (Fig. 90), the mucous membrane thoroughly detaches itself from the face of the uterus, but, very probably, the base of the utricular glands remains, and thus covers the muscular tissue, which is never bare. From this standpoint, at the onset of labor, a new mucous membrane already exists, between the old and the muscular coat, and this begins to form at about the fourth month. This new membrane does not exist at the placental site, since that covering this site is not shed. Indeed, vascularization not only does not diminish, but, on the contrary, is ever on the increase. The only part of the mucous membrane between uterus and placenta which is shed, is that immediately around the placenta, and this falls away with it, the remainder clinging to the uterus. And hence the projection at the placental region, a projection all the more marked because of the fact that the uterus has energetically contracted, and its thickness increases on account of the contraction of the muscular coat. The utero-placental portion of the mucous membrane of the uterus, which does not follow the placenta, is never shed. It persists, and diminishes in size, until it approaches the level of the new mucous membrane. In certain women the placental site remains more projecting during many years.

This opinion of Robin's is rejected by Friedländer, Kundrat and Engelmann, Langhaus and Leopold, who contend that the uterine mucous membrane is never shed from any portion of the surface. This surface, the muscular tissue in a word, remains always covered by the external layer of the mucous membrane, the most internal layer of this membrane being the only one which is shed, and is expelled with or dragged away by the placenta. The epithelial layer, therefore, is shed, the separation taking place at about the middle of the cellular layer, at the time of the detachment of the membranes. During the puerperium, the persisting portions of the cellular layer rapidly undergo fatty degeneration, the glands are brought into intimate contact, owing to the degeneration of the intervening tissue; through proliferation of their epithelium, new cells are formed to replace those which existed on the old mucous membrane, and these cover the entire inner face of the uterus, and the fibrous elements, which have likewise been destroyed, are reproduced by a proliferation of new elements. Friedländer, in a second monograph, and Kundrat and Englemann, as well as Langhaus, prove that the separation occurs within the cellular layer of the mucous membrane, in the glandular layer of Lang-

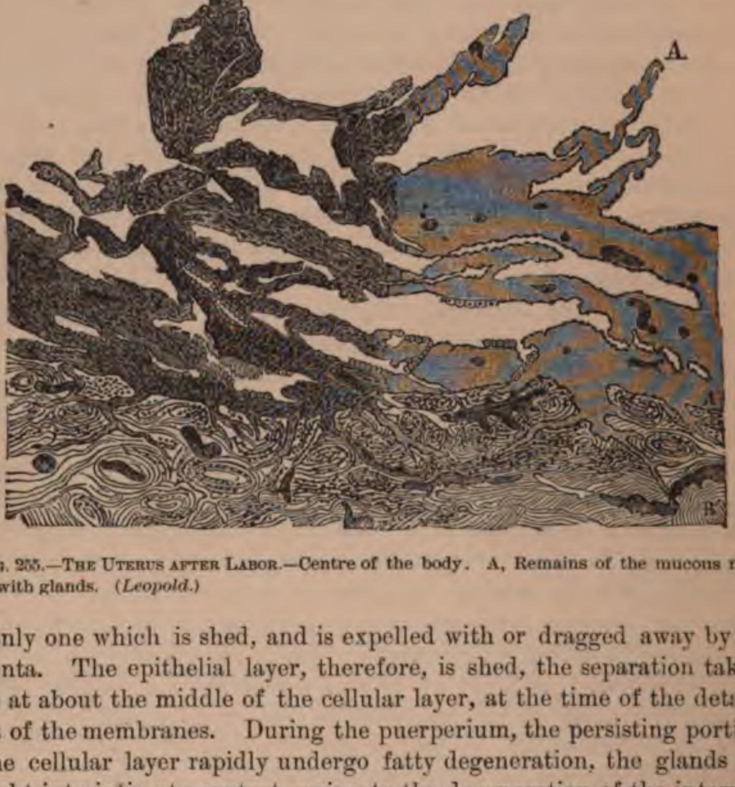


FIG. 255.—THE UTERUS AFTER LABOR.—Centre of the body. A, Remains of the mucous membrane with glands. (*Leopold.*)

haus. The superficial layers of the mucous membrane undergo fatty degeneration, but the glandular spaces persist, and constitute for the moment, the superficial layer of the uterus; then, the epithelium, which has remained in these glandular spaces, begins to proliferate, and the inter-glandular fibrous tissue reproducing itself, and the glands lengthening, the new mucous membrane is formed. But, according to Langhaus, this proliferation, (and herein he nearly agrees with Ch. Robin,) is but the conclusion of a process begun during pregnancy.

In 1877, Leopold published the most complete work we possess on the regeneration of the mucous membrane. Immediately after labor (Figs. 255 and 256), three distinct zones are discovered on the internal surface of the uterus; the first extends from the external to the internal os; the second includes the remainder of the uterine surface, except the placental site; the third is the placental zone. The three differ in appearance.

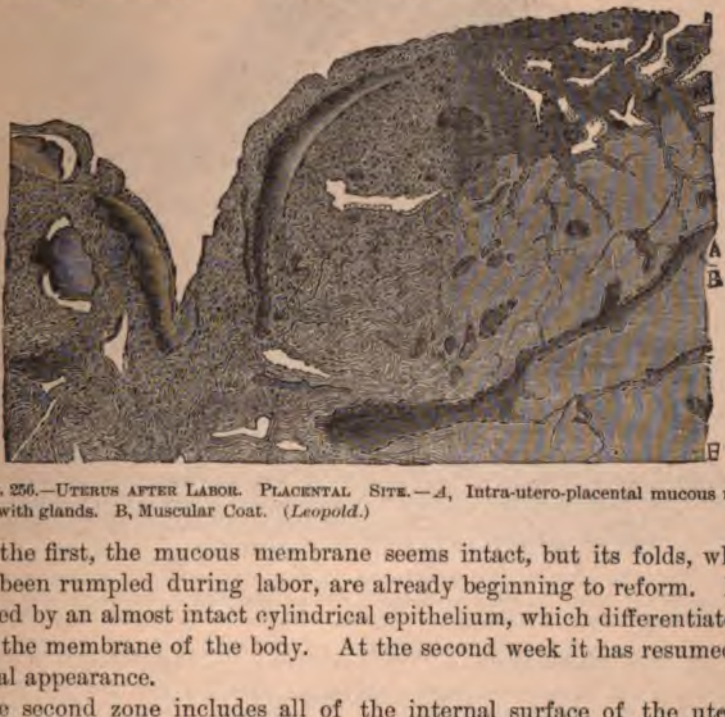


FIG. 256.—UTERUS AFTER LABOR. PLACENTAL SITE.—*A*, Intra-utero-placental mucous membrane, with glands. B, Muscular Coat. (*Leopold.*)

In the first, the mucous membrane seems intact, but its folds, which have been rumpled during labor, are already beginning to reform. It is covered by an almost intact cylindrical epithelium, which differentiates it from the membrane of the body. At the second week it has resumed its normal appearance.

The second zone includes all of the internal surface of the uterus, except the placental site. The line of separation is in the spongy layer of the decidua vera and the serotina, always above the muscular coat, and this spongy layer is made up of the glandular layer, the ampullary of Friedländer and of Langhaus.

The third zone has an appearance peculiar to itself. The decidua serotina, sending branches into the inter-cotyledonary spaces, as soon as the placental site sinks, projects, and forms a series of depressions and elevations, covered by a remnant of the serotina, from $\frac{39}{100}$ to $\frac{58}{100}$ inches in thickness, but this serotina is not continuous, because its continuity is interrupted by the large sinuses which are uncovered, and filled with blood. The demarcation between the placenta and the serotina, occurs here in the deeper layers, but the glands, thus torn, still open at the surface; there remains, therefore, of this mucous membrane, only the external half, that is to say, the one which is made up of numerous torn glandular spaces, deprived of epithelium, of inter-glandular rifts, of lymph spaces and of blood vessels. The glandular pouches alone retain their epithelium, and they are the ones which are going to assist in the regeneration of the mucous membrane.

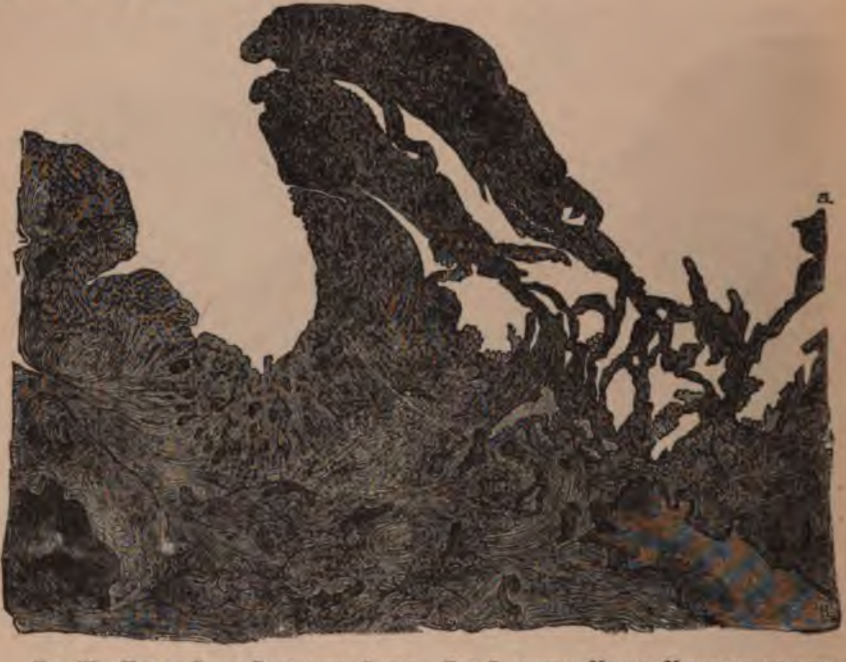


FIG. 257.—UTERUS SEVEN DAYS AFTER LABOR. THE PLACENTAL MUCOUS MEMBRANE MERGING INTO THAT OF THE BODY.—*A*, Mucous membrane with remnant of the glands. *B*, Muscular coat with beginning thrombosis. (*Leopold.*)

Seven days after labor (Fig. 257) the uterus is 4.6 to 4.8 inches in height; its cavity is 3.9 inches; its internal surface is covered with a reddish-brown coat, showing a number of little blood spots and very hyperemic vessels. The mucous membrane of the cervix is ruffled, and is composed of numerous blood vessels and scattered cells; it is clotted with cylindrical epithelium and with large nuclei. Beginning at the internal os, the internal surface of the uterus, to the level of the placental site, is covered by a soft membrane, reticular, and with studded surface. This membrane, of the thickness of from .039 to .058 inches, is a little thicker at the border of the placental zone, and is higher above its level. Under the microscope it is seen that the irregular folds, which existed on its surface, have been destroyed by fatty degeneration of the cells, and that the internal surface has become smooth, the glands vertical and widely open, and that the epithelium has proliferated from the bottom to the surface, above the glandular walls, up to the most superficial surface. Between these young glands, the epithelium extends cell by cell, and it is traversed by so many capillary vessels, by so many blood and lymph corpuscles, that it is not as yet a question of definite structure.

The third zone, the placental, is 1.9 to 2.3 inches wide, and it projects 1.9 to 2.3 inches, covered by a layer about .019 inches thick, reddish-brown, friable, composed of detritus made up of decidual cells which have undergone fatty degeneration, of blood and lymph corpuscles, of isolated glandular epithelium, and of *débris* of fibrin. At the border is found the destroyed remnant of the glandular layer; the most superficial of these are traversed by fatty molecules and blood corpuscles, surrounding the vessels and almost obscuring the cells of the decidua. In the front rows these glandular spaces look rather like gutters, containing here and there epithelium and blood corpuscles, than true glands. At the centre of the placental zone the projections have been levelled off; they are made up of the large cells of the serotina, which have accumulated in the furrows left by the projections. Frequently, there are found glandular

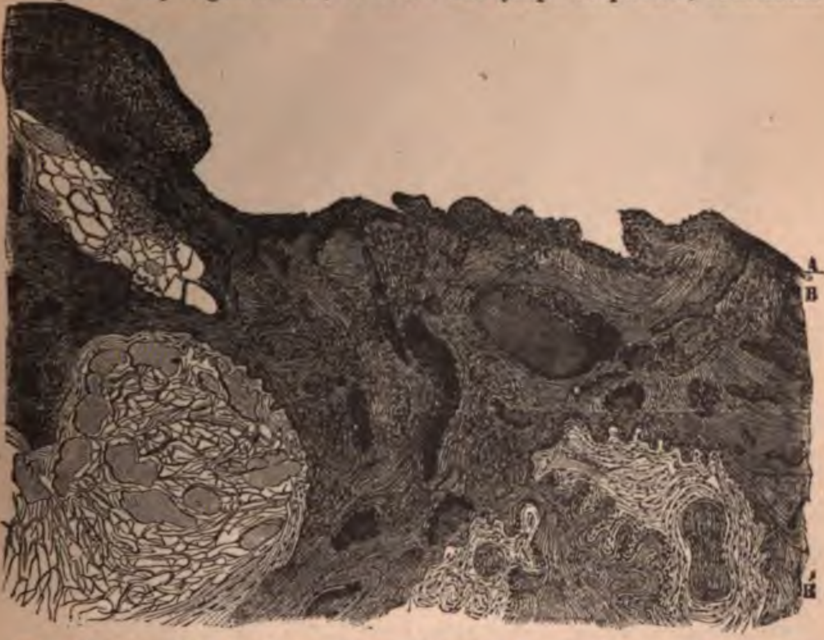


FIG. 258.—UTERUS NINE DAYS AFTER LABOR. PLACENTAL SITE.—*A*, Remains of the mucosa. B. Muscularis with recent and old thromboses. (*Leopold.*)

rows furnished with epithelium, and well preserved. The blood-vessels are filled with large thrombi, old and recent, the first of which go back to pregnancy; the vessels are small in size, and their walls are thickened.

Nine Days after Delivery (Fig. 258).—The limit of the mucous membrane of the cervix and of the body, at the internal os, is well marked. The mucous membrane of the body, .039 to .078 inches thick, is made up of a number of vacuoles, forming, in their depth, large spaces, opening at the surface, and these are new glands; they are lined with epithelium, with large nuclei, which multiply and form epithelial islets, which, here and there, cover the surface. Between the glands are found vessels, small and large, here and there without walls, also round cells, blood corpuscles, fat nuclei; cells fattily degenerated, and a tissue in the stage of new formation, which seems granular.

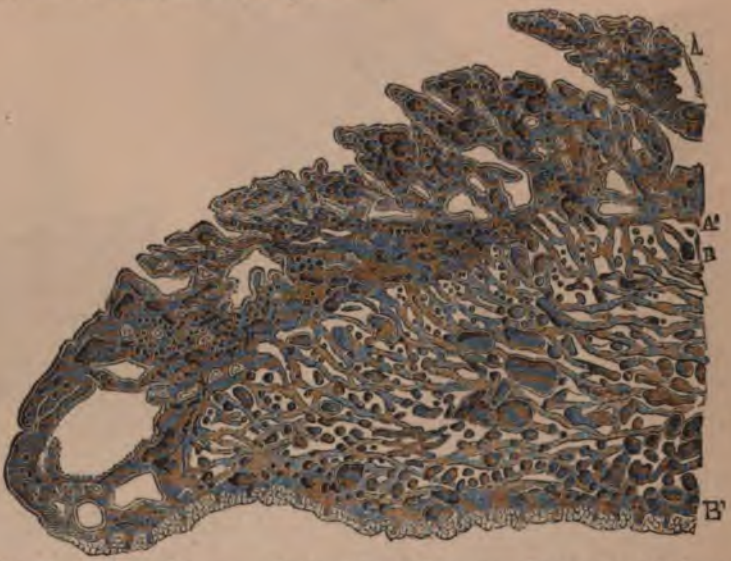


FIG. 259.—ANTERIOR LIP OF THE CERVIX, FIFTEEN DAYS AFTER DELIVERY.—*AA'*, Mucosa. *BB'* Muscularis. (*Leopold.*)

Fifteen Days after Labor (Fig. 259).—The membrane on the internal face of the uterus is greyish-brown, .039 to .078 inches in height, still smooth and easy to detach, while the cells filled with fat are still to be seen on the surface. At the bottom of this young mucous membrane the glandular spaces tend to become vertical, and there exists proliferation of epithelium and of fibrous tissue. In the placental zone, organization and softening of the thrombi are going on. In the spaces which separate them, the young tissue of the mucous membrane developes, and the epithethelium is in the form of a thin layer, extending to the top of the projections. The uterus, hence, presents a granular surface, so friable that it is possible to separate its elements readily, and it is just as ready to absorb septic products as on the seventh day.

Twenty-one Days after Delivery (Fig. 260).—The uterus is only 3.1 to 3.6 inches long; its walls are thinner, the cervical canal has reformed, and the internal os, easily recognized by the demarcation of the mucous membrane, has tightly closed; the placental site, still of the breadth of 1.1 to 1.5 inches, is uneven, projecting here and there, and traversed by thrombi. Above the superficial greyish layer, a new mucous membrane has formed, about .039 of an inch thick, which merges directly into the mucous membrane of the body of the uterus; but although complete in all its elements, the new mucous membrane is still not entirely intact; it is still like a wounded surface; it is still lacking in sufficient thickness, and, above all, in its circulatory net-work, which was torn off with the membranes, and which is of such importance to the functions of this membrane. The thrombi have largely disappeared, but in places they still exist as light yellow bodies.

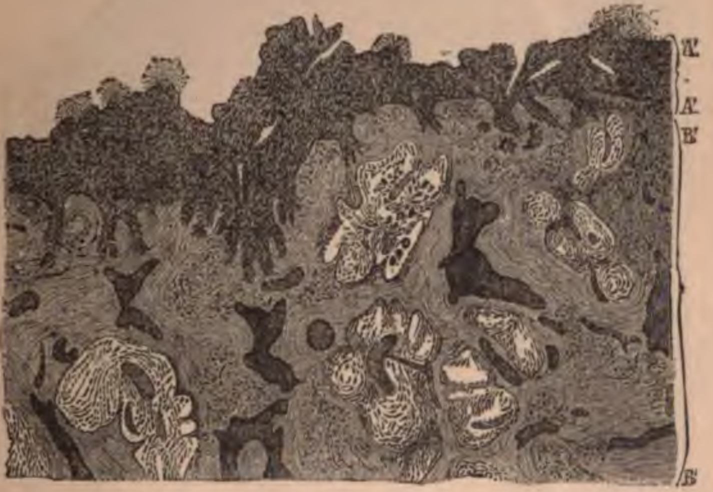


FIG. 260.—PLACENTAL SITE THREE WEEKS AFTER DELIVERY.—*A'A''*, Mucosa, newly formed. *B'B''*, Muscularis, with thromboses. (*Leopold.*)

Six Weeks after Delivery (Fig. 261).—The new mucous membrane has thickened; the return to the normal has been almost accomplished, except at the placental site, where it is less complete. Above the superficial layer the vascular net-work is complete.

Finally, ten weeks after delivery (Fig. 262), the mucous membrane is entire. In case inflammatory processes have existed, not only, as Kundrat has shown, is total involution of the uterus interfered with, but, in particular, is regeneration of the mucous membrane irregular. In such cases, the normal glandular organs, are only reformed at the expense of those original glands which have remained intact, and there results only an incomplete mucous substratum, made up, especially, of connective tisith certain glandular depressions not markedly accentuated, and ng scarcely any epithelium.

THE LOCHIA.

uring the above process of regeneration, there are excreted from the us a number of products, which together constitute what are called lochia. The lochia, composed almost entirely of pure blood, have n called, according to the predominance of blood corpuscles or leuytes, bloody, serous, sero-purulent, milky. Robin has shown that this ter term is erroneous, for the lochial discharge never contains true pus, but only a pseudo-pus, of a stale odor, and alkaline reaction. This discharge is only truly bloody during the first three days. It becomes serous from the third to the fifth day. There are variations, however, in different women.

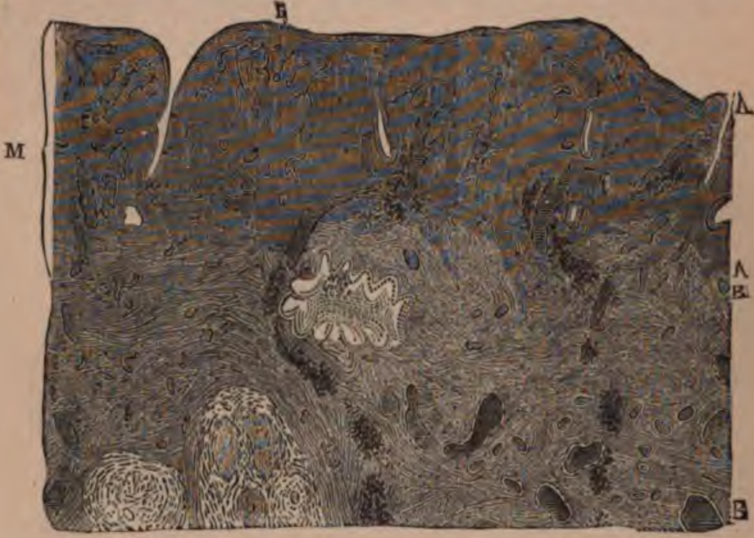


FIG. 261.—THE UTERUS SIX WEEKS AFTER DELIVERY.—New mucosa at the placental site. Thrombus in the broad ligament. *AA'*, Superficial layer of cells and of glands in the new mucosa. *BB'*, Muscularis with thromboses. *M*, Mucosa. *a*, Hematoidine. *b*, Vessels. (*Leopold.*)

Almost exclusively made up of blood during the first hours, from the second to the fifth day, according to Wertheimer, the discharge is composed of a serous liquid, containing larger or smaller masses of vaginal mucus, which, mingling in the vagina with blood corpuscles, forms a sediment. Under the microscope are found: 1. Blood corpuscles. 2. Elliptical and polygonal epithelium, nucleated. 3. Mucous corpuscles. 4. Sometimes remnants of placenta or of membranes. Chemical analysis reveals albumin, the albuminate of soda, mucus, fat, chlorides, alkaline phosphates, iron, lime, salts. The solids vary in amount from 267.6 to 86.2 parts per 1000. From the fifth day the blood corpuscles diminish greatly. They are altered in contour, modified in form, and we find in the lochia pus corpuscles according to Wertheimer, leucocytes according to Robin, an epithelium which has changed from elliptical and polygonal to round, nucleated cells, free nuclei and fat globules.

Schroeder has found in the lochia the trichomonas vaginalis, and Scherer, who has studied the lochia since Wertheimer, finds: "During the first few days, the predominating elements are the constituents of the blood, albumin and globules, in the shape usually of molecular granulations. There is no fibrin; uterine and vaginal epithelium is found, as well as shreds of placenta. After a few days, the epithelium almost entirely disappears, the blood corpuscles are less abundant, the discharge becomes of a dirty red color, and many mucous corpuscles are found (abortive epithelial cells). Little by little, the discharge becomes more viscid, and at the same time more perfect epithelium is found. Mucin appears, instead of true albumin." (Naegelé and Grenser.)

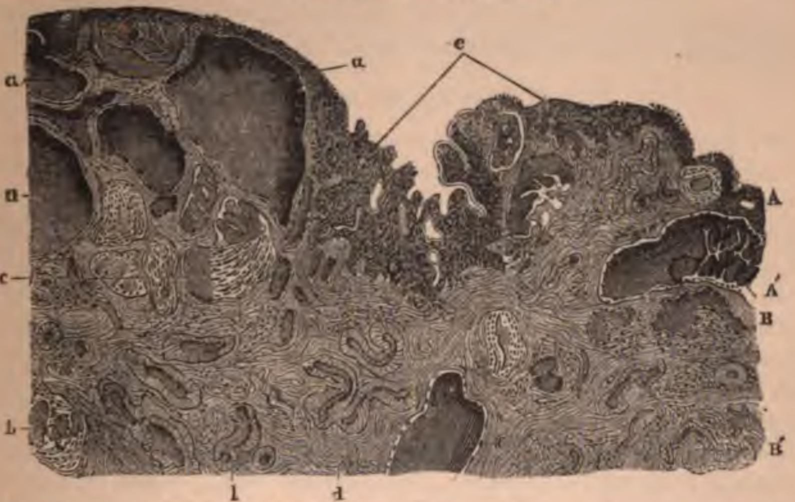


FIG. 262.—UTERUS TEN WEEKS AFTER DELIVERY. INCOMPLETE REGENERATION OF THE MUCOSA AND THE PLACENTAL SITE.—*AA'*, Islets of new glands and of epithelium. *BB'*, Muscularis with old and recent thrombi. *a*, Thrombi and coagula. *b*, *c*. Tubercles. *d*, Uterine sinus. *E*, Epithelium. (*Leopold.*)

According to Gassner, the amount of the lochia is 2⅓ pounds during the first four days, (red lochia), ¾ of a pound from the fourth to the sixth day, (serous lochia), and up to the ninth day, ½ pound (white or green lochia). The total during the first eight days is about 3½ pounds. This quantity is doubled in women who do not nurse.

The duration of the lochial discharge is variable. Usually the discharge continues until the re-appearance of the menses, that is to say, till the sixth week, in women who do not nurse. In those who do nurse the duration is somewhat less, but there is no absolute rule. It is not unusual for the lochia to diminish notably for a few hours, and then to reappear more abundantly, even as when they have become serous they may return to the red for a day or two, again to change to greyish-white. Lactation seems to greatly modify them; often, at the onset of the function, they diminish markedly, sometimes to complete suppression, to reappear as abundant as usual when the function is established. Depaul agrees with Gassner in the opinion in regard to the increase of lochia in women who nurse.

The odor of the lochia is stale, not normally very pronounced, and fetor is always a grave indication, since it always points to deep lesions of the genital tract, or to more alarming puerperal accidents. The same remark applies to acute suppression, or too rapid disappearance of the lochia. If, indeed, we consider the lochia as the external manifestation of the phenomena occurring within the genital organs, of the process of involution in other words, this suppression always coincides with a temporary arrest of involution; and since the first phenomenon which accompanies puerperal pathology is the arrest of involution, the importance is at once apparent of the regular and normal flow of this discharge.

THE MODIFICATIONS IN LACTATION.

We have seen that during pregnancy, the breasts undergo marked changes, and that in many women, it is possible at the end of pregnancy to express a few drops of milk from the breasts. But this milk is serous, yellow, and contains only a few true milk globules. From the second day, oftener the third after delivery, the milk is secreted.

According to Schroeder, the sources of the milk are two. The liquid portion is a simple transudation from the blood, and the morphological elements come from the gland cells of the breast. In these glands, under the influence of swelling of the cells, there is produced a finely granular deposit, which unites into drops of fat. (Figs. 263 to 265.) The primitive glandular cells, round, finely granular, which have lost their nuclei, are known as colostrum corpuscles. Finally, these break up into fat drops of different size, and, together with the transudation from the blood, form an emulsion: this is the milk. (Schroeder.)

The colostrum, which is yellow-white and sweet to the taste, contains much butter and sugar. When fresh it is alkaline.

Simon, in 100 parts of colostrum, found: Solids 17.20; casein 4; sugar 7; butter 5. The perfected milk contained only 11.23 solids.

Marchand, in 100 parts of colostrum, found: Proteids 17.20; lactine 6.30; butter 4.50; salts .25; water 71.63.

In 100 parts of milk, he found: Proteids 1.90; lactine 5.30; butter 4.50; salts .18; water 88.12.

Under the microscope, milk contains a large number of semi-transparent globules, varying in size, and isolated epithelial cells, at times mucous globules. According to Raspail, the milk globules are composed of albumin and of fat; Henle and Simon believe that their coating is casein, and their contents is fat. Donné and H. Nasse believe that the milk globules are simply fat. According to Schroeder, the fatty parts of the milk are composed of albuminoid matter, and the albumin of the colostrum is transformed into casein. Kemmerich has shown that in colostrum fresh from the breasts, casein increases as albumin diminishes; nevertheless, according to Zahn, perfect milk contains a little albumin. Kehrer says that the casein is contained within the *débris* of the glandular cells, which, swollen, and rendered invisible, make, with the serum of the milk, a clear mucus, and determine the emulsion of the fat globule.

The colostrum contains fat globules (often, also, mucous corpuscles, and pavement epithelial cells), and, in addition, granular, round corpuscles, yellow in color, larger than the milk globules, and these corpuscles are known as colostrum corpuscles, granular bodies of Donné, who first described them. They are in particular abundant in the first days of the puerperium, and do not completely disappear till the fifth or sixth day, according to Donné, till the end of a few weeks, according to other authorities.

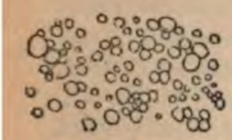


FIG. 263.—MILK GLOBULES.

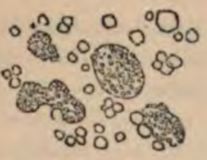


FIG. 264.—MILK WITH COLOSTRUM CORPUSCLES.

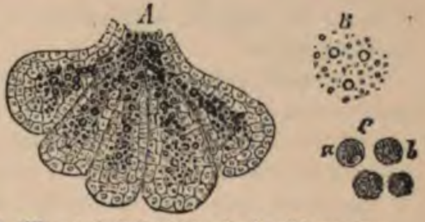


FIG. 265.—*A*, Lobule of the gland, with escaping milk. *B*, Milk globules. *C*, Colostrum. *a*, Fat cells. *b*. The same without nucleus. (Magnified 280 diam.) (*Virchow.*)

Milk contains a mixture of fat drops, more or less voluminous, and these are the milk corpuscles, which are surrounded by an albuminoid membrane, which Ascherson has called the haptogene membrane. (Naegelé and Grenser.)

The phenomena which accompany the establishment of the function of lactation have been carefully studied by Chantreuil, and he makes the distinction into local and general phenomena.

Local Phenomena.—These are the increase in size and in consistency of the breasts, the excretion of the milk, the changes in the nipples.

At the end of the second day, usually during the third, the breasts increase in size, the skin becomes tense, traversed by bluish vessels. The nipples project less. At the moment of the appearance of the milk, the milk ducts are felt hard under the skin. If the breast be squeezed at the level of the nipple, the milk exudes. Frequently, above all in the primipara, an œdema, generally localized at the areola, results. When the function of lactation is established, sugar appears in the urine. According to Blot, glycosuria is a constant accompaniment of the puerperium, appearing with the milk, and disappearing at the end of lactation. Blot calls it, on account of its constancy, physiological glycosuria. Le Conte denies the truth of Blot's assertion, and says that the reaction obtained by him was not that of sugar, but of uric acid. The researches of Benecke, Winckel, etc., in Germany confirm Blot's opinion.

General Phenomena.—These are constituted by the symptoms accompanying what was formerly called milk-fever, the existence of which is denied to-day, and which, according to those who believe in it, manifests itself by cephalalgia, neuralgic pains, slight chills followed by heat and perspiration, thirst, anorexia, coated tongue, rapid pulse.

For our part, we do not believe in milk fever; without denying its very existence, we believe it to be exceptional. In 1863, we cited a number of instances, and we have since noted others, which are incontestible, where the appearance of the milk was accompanied by high febrile reaction, preceded by a marked chill, and disappearing at the end of twenty-four hours, aside from any treatment, but purely because the function of lactation was established. The rise of temperature, it was impossible to consider due to a morbid phenomenon, and which we, consequently, believe we are right in attributing to the physiological congestion of the mammæ alone.

Chantreuil, in his study of milk-fever, analyzes the symptoms which have been enumerated, and says that he has never observed the chill in any one of the fifty cases under his own observation. Blot has noted it twice, and we have seen it twice in the same woman, in different confinements.

The pulse, according to Lorrain, might be modified in its form and frequency, when lactation passes the physiological limits. In fifty women Chantreuil found the pulse:

In 16 above 76; in 21 between 76 and 100; in 13 above 100.

In the first series, no fever, but the physiological slowing of the pulse was less marked.

In the second series, there were sub-febrile phenomena, but in the women there existed great distension of the milk ducts, faulty development of the nipple, tardy appearance of the milk or incomplete, either from the mother's unwillingness to nurse or congenital weakness of the infant, fissures, ulcerations of the nipples, after-pains, slight metritis, scarlatiniform eruptions.

In the third series, alarming abdominal affections, variola.

The temperature, taken in the axilla, was never, in the normal cases, elevated more than one half degree. Chantreuil's researches included the entire time requisite for the establishment of the function, that is to say, during the third, fourth and fifth day. He concludes: "1st. The morbid entity, called milk-fever, exists only very exceptionally. 2. In normal cases, the pulse does not range above 76 while lactation is becoming established, and hence, there is no question of fever. 3. The temperature ranges with the pulse. A. In normal cases, the absolute temperature is not elevated, while the function is establishing, above 98.2 to 99.4 F., figures which have, by common consent, been adopted as normal. B. Our researches teach us that the temperature after rising immediately after labor, falls the next day, rises during secretion of the milk about ½ a degree, and then falls, or rises later according to circumstances. C. This slight rise in temperature may be attributed to the physiological work the mammæ are performing, but also to solutions in continuity of the genital organs, and to the modifications which are occurring throughout the body as a whole at this time. D. A rise above one degree points to the presence of some morbid factor with the establishment of lactation."

[In one hundred puerperæ, primiparæ and multiparæ, noted especially in regard to the so-called "milk-fever," our own conclusions accord with Chantreuil's. Septic causes aside, a rise of temperature above 1° F., during the first three days after labor, calls simply for a cathartic. True milk-fever we have never seen.—Ed.]

CHAPTER XX.

THE MANAGEMENT OF THE NORMAL PUERPERIUM.

IN a former chapter we stated that the physician should not leave his patient until he was satisfied that there was no danger of hemorrhage, syncope, etc. She should then be left in perfect quiet, and will soon sleep, and this sleep should not be disturbed, since she is exhausted by the efforts of labor. It is often a good plan to administer a little stimulant before she goes to sleep. The physician should make his next visit within six or eight hours after labor, and if delivery has occurred during the night, the first morning visit should be made to the last woman delivered. It is customary with many physicians to give a dose of ergot to the patient before leaving. We do not believe this at all necessary, and we do not give ergot except where the uterus seems inclined to relax. [The object of the administration of ergot being to guard against such relaxation, and the physician never knowing in what special case such relaxation may occur, it seems the better plan to administer the drug immediately after the delivery of the placenta, *not before*, as a routine measure. Ergot, so far as is determined, can do no harm, and it may do good. At any rate we feel more satisfied with the future of our patient if we leave her protected by ergot. In those cases where there is a tendency to relax, and where in consequence we may have hemorrhage, we would give a double dose by the mouth, or, better still, one drachm subcutaneously, deep into the abdominal muscles always, never superficially for fear of causing abscess.—Ed.] We apply over the abdomen a sheet, folded a number of times, or else a moderately tightened binder. The patient should lie on her back for a number of hours after delivery, and the toilette of the vulva should be attended to at least four times in the twenty-four hours, and carbolized water, one part to 100, should be used. [On account of its unpleasant odor, carbolic may be dispensed with, and corrosive sublimate, 1 to 4000, substituted. In private practice we question if pure boiled water be not amply sufficient. As for the dressing for the reception of the lochia, to which no reference is made in the text, the old-fashioned napkin should be rejected, and absorbent cotton substituted. A pad of this cotton, antiseptized or not, according to individual taste, should be laid against the vulva, and retained in place by an ordinary T bandage, which is pinned in front and behind to the abdominal binder. This makes a clean and comfortable dressing, and the cotton should be changed as soon as saturated, and this will vary with each patient according to the amount of the lochia.—Ed.]

At the first visit we should assure ourselves of the height of the fundus of the uterus. Not uncommonly it is inclined towards one or the other side, usually the right, and reaching to the umbilicus. This elevation of the organ is due entirely to the distension of the bladder. If the woman cannot pass her urine, it must be drawn by the catheter. This retention of the urine usually disappears at the end of twenty-four hours, although it may last much longer; we have seen it last to the fourteenth day. The woman should be catheterized at least every twelve hours. [This we do not believe is often enough. At the end of six hours, at least, vesical distension is great enough to call for artificial aid, if the patient cannot pass her own urine. As a practical point in regard to the catheter, and one not insisted upon sufficiently, we would state that the catheter should always be passed by sight, never by touch, and that prior to its introduction the vestibule should be carefully cleansed. Thus the introduction of lochia into the bladder on the point of the catheter is avoided, and therefore a possible cause of cystitis.—Ed.]

The toilette of the newly delivered woman should be made with the greatest possible care, and every cause of infection kept away from her, and from the lying-in room. Soiled linen, napkins, should be frequently changed, and taken from the room. The air in the room should be often changed; in summer the window may be left open from nine in the morning to seven in the evening. If the genitals are abraded, they should be covered by a compress wet in a solution of phenic acid, 1 to 100. For our part, this external toilette is not sufficient, and, in accord with the majority of foreign and French accoucheurs, we cause to be given to all our patients, from the day after delivery, vaginal injections of some antiseptic fluid. We are so convinced not only of the innocuousness, but of the advantage as well, of these injections, that if the labor has been longer than usual, or we have been obliged to interfere, or the woman has given birth to a dead, putrified or macerated child, we begin with them immediately after labor. One injection, night and morning, is enough for ordinary cases, but we give them every two to three hours, if the lochia become fœtid. We use phenic acid solutions, 1 to 100, and the injections are administered from Eguisier's irrigator, with a tube with lateral openings. The irrigator should first be filled as well as the tube, and the fluid should be allowed to flow gently. In other words we simply aim at washing out the vagina. The water should be of a temperature of 90 to 95° F. In general, we resort simply to vaginal injections, reserving intra-uterine for special cases. (See subject of Puerperal Fever.)

[While we would not be understood as condemning the above practice, our belief is exactly the reverse. In the normal puerperium we are satisfied that vaginal injections are useless, and that women will pass through exactly as normal a puerperium without them. This applies with all the greater force to private practice, when we state that at the New York Maternity Hospital, vaginal injections, in normal cases, have been entirely dispensed with, and that it is the exception at this institution to see the temperature rise more than one to one and a half degrees above the normal, and this rise, during the puerperal period, is of no moment. Our only objection to vaginal injections, as a routine measure, is that they may readily be the source of infection, especially if our nurse be careless. The better plan, is never to touch the vagina, during the puerperium, with finger or with syringe nozzle, unless symptoms call for it, and the chief symptom is fœtid lochia, when vaginal injections should be at once resorted to, followed, if need be, by intra-uterine. In case of instrumental interference, or the birth of a fœtid child, we would go further than Charpentier, and wash out, not alone the vagina, but the uterus once, thoroughly, immediately after the expression of the placenta. We would further prefer sublimate, 1 to 4000, to carbolic, except where frequent irrigation is called for, and then, remembering the possibility of poisoning from this substance, would substitute carbolic, or clean boiled water.—Ed.]

The woman's stay in bed should be prolonged as long as possible—it should be absolute for the first six days. It is only at the end of this time that we allow the bed to be re-made. The woman should be carried to another bed, or where she is too heavy, we can place the second bed by the side of the first, and she may roll herself into it. Thereafter the bed should be changed every two to three days. She should remain in bed at least three weeks, oftener longer, than less; all depends on the process of involution. At the end of this time, she may be allowed to change to a sofa or a reclining chair. Only at the end of the thirtieth day will we allow her to walk, and only at the end of the fifth week should she resume her household duties. She should not venture out before the sixth week. We would like to wait for the return of the menses, which is usual about this time, but this is impossible with women who feel well. When the menses return, we make our patients return to bed, or at least to a reclining position, for two to three days. The first outing should be on foot, and it is only after some days that we allow the use of the carriage. Convinced as we are of the slowness with which involution occurs, and of the influence of involution on the production of uterine disease, we believe it right to insist on prolonged rest after delivery, and the more women retard the resumption of their customary duties, the more they assist perfect involution, and consequently the more likely they are to possess perfect health. It goes without saying that if, before labor, the woman has had uterine disease, (metritis, displacement, etc.), her sojourn in bed should be further protracted, and that we cannot indicate the exact limit.

When the woman leaves her bed, we allow her to wear corsets, but we insist on an abdominal supporter being also worn for at least six weeks. This is particularly important in women who are very stout, and in those who have borne many children, since the abdominal walls have lost more of their elasticity.

As for the food of the puerpera, we make it as generous as possible, allowing her to resume her ordinary food on the second day after delivery. On the appearance of the milk, if the woman is not going to nurse, we reduce greatly the amount of food until the breasts have diminished in size.

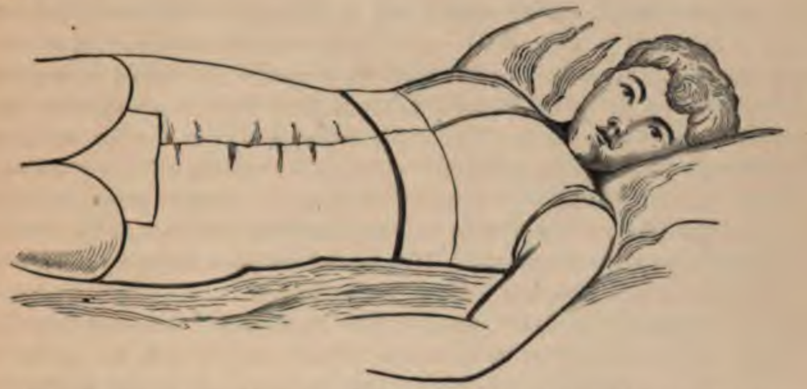


FIG. 266.—BREAST, ABDOMINAL AND VULVAR BANDAGE IN USE AT THE NEW YORK MATERNITY HOSPITAL.

Constipation is the rule during the puerperium. We never order either enemata or purgative before the third day. If enemata of oil and glycerine do not suffice to move the bowels, or if the woman is not going to nurse, we await the advent of the milk, and on the fourth day order a purgative, renewing it every two to three days until the breasts have diminished. These should be covered with cotton soaked in warm camomile oil, and sustained and lifted forward by a napkin; in case of excessive distension, the mammæ should be gently poulticed. In many instances it is good practice to compress these organs. To accomplish this, the

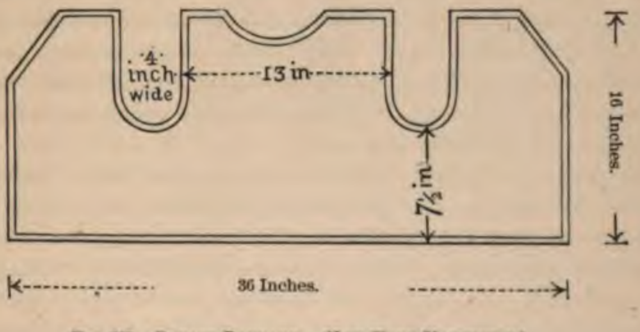


FIG. 267.—BREAST BANDAGE. (NEW YORK MATERNITY.)

breasts are covered with plaster, over this is applied a number of layers of cotton, and the whole is held in place by a tightly pinned bandage.

[It is frequently a problem to the general practitioner to determine the best and most painless manner of treating excessive distension of the breasts, or of drying up the milk in cases where lactation, for one or another reason, is not possible. The method in use at the Maternity commends itself as the simplest, most effective and least painful. Equable compression is what is aimed at, and this is obtained by means of the breast binder referred to, (Fig. 267). The dimensions in the cut will suit the average case. In case of simple distention, equable compression is alone necessary, and under it the milk will ooze through the bandage, and the mammæ diminish in size. Where the object is to dry up the milk, the following is the method. A full saline purge is administered. The breasts are rubbed with an atropia ointment (gr.j to ℥j). A layer of cotton is placed evenly over them. The binder is then tightly pinned down the centre, and finally over the shoulders. This binder remains in place for at least one week, being tightened as it relaxes.—Ed.]

If the woman intends to nurse her infant, it should be applied to the breast at the end of eighteen to twenty-four hours, and no earlier, in order that the woman may obtain complete rest. It is not unusual for after-pains to follow on the application to the breast. [It seems to us better practice to apply the child to the breast within three to four hours after delivery. The woman is then sufficiently rested, and we further obtain the earlier action of the breast on the uterus, firmer uterine contraction, and this we want.—Ed.]

As for general hygienic rules, they are as follows: keep away from the patient all causes of worry or excitement; do not allow many visits to be made during the first ten to twelve days; do not burden her with too much bed-clothing; keep the temperature of the room at about 80° F. In winter, have a fire night and day. Air the room frequently, and remove at once all causes of foul air.

If the woman is going to nurse, regulate the child's nursing periods from the start, and see that fissures do not form on the nipples. It is our custom to cause the nipples to be washed, during the first few days, with tincture of arnica. When the infant has finished nursing, wipe the nipple carefully, and grease it with cocao butter. [We cannot be too careful of the nipples, and it is an excellent plan to wash them carefully each time the child is applied to the breast, and at once after. Pure water answers as well as anything else, except where the nipple is tender, and then the compound tincture of benzoin will harden them effectively. Further, it is not alone sufficient to wash the nipples, but the child's mouth should be washed as well, before applying it to the breast. Thus we assist in the prevention of fissure and erosion for the mother, as well as of sore mouth to the child.—Ed.]

In certain women, lactation is followed by hemorrhage, which returns at each nursing. If this continues longer than two or three days, nursing should at once be interdicted. In other women, it is only at the end of a few weeks that such hemorrhages occur, and they may be so marked as to become alarming. Ergot internally, or subcutaneously, astringent injections, vaginal and uterine, avail nothing. The one thing to do is to put a stop to lactation: if this do not suffice, there is one measure which has answered us, and Tarnier, and Bailly admirably—this is a hot bath at 98.5° F.

A curious instance of the kind happened in our practice, and the following is a brief account: a young woman, nursing her third child, was seized on the twenty-eighth day after delivery with loss of blood, which finally became abundant. At the end of two days lactation was put a stop to. This, however, did not suffice, and notwithstanding every conceivable means, the hemorrhage continued for eight days. On the ninth, she was given a hot bath, 97°, and remained in it one hour and a half. The hemorrhage at once diminished, and disappeared on the next day after a second bath. Fifteen days thereafter, and twenty-three days after the appearance of the hemorrhage, the woman endeavored to nurse her child: the milk returned, and lactation was kept up for fifteen months.

Under the influence of the abundant perspirations which affect the puerpera, it is not unusual to see an eruption appear like scarlet fever, but it should not be confounded with this.

About the fifteenth day we allow the woman to read, and to do a little fancy work. She may at the same time sit up in bed, although this depends on the state of the womb. As long as it is appreciable through the abdomen, we counsel rest on the back, and if involution be slow we give, every two to three days, subcutaneous injections of ergot, to hasten the process. Except in case of hemorrhage, we do not allow the full bath until the menses have returned. [This is an entirely unnecessary precaution. American women, indeed, would not submit to any such rule. Frequently, in nursing women, menstruation does not occur for a number of months. Hygiene, if not dirt, requires a full bath before the expiration of such an interval, and such a bath can do no possible harm.—Ed.]

There remains still a very delicate question, and this is when should sexual intercourse be resumed? Certainly not till the menses have recurred, usually about the sixth or seventh week. Before this period the husband should sleep apart from his wife. In certain young and impressionable women, the mere presence of the husband in the bed will provoke sexual feelings, which may result in uterine hemorrhage. We have in mind two incontestable examples of the kind.

CHAPTER XXI.

THE CARE OF THE NEW-BORN INFANT.

WE do not propose to enter here into details. We simply aim at laying down certain rules which concern the management of the infant during the first few days. Being strongly opposed to artificial feeding, we will speak only of the infant which is nourished by the mother or a wet-nurse.

The cord having been tied, and the infant washed and clothed, it should be placed in its crib, and surrounded, especially in winter, by hot water bottles. Usually, before placing the child in its crib, nurses give it one to two teaspoonsful of sugar water. Without being harmful, this custom is useless. The infant should lie in its crib, on its side, the head slightly elevated, and with its back turned towards the light. It is important to keep it out of any draught. It should never be allowed to sleep in the bed with the mother. Aside from the fact that her rest is thus disturbed, the infant is exposed to inhaling the perspiratory and lochial odors, and this must be harmful. During the first few hours, it is not rare to see mucus flowing from the mouth and nose. This should be removed. The child shortly ceases to cry, and goes to sleep. It should not be rocked, as is customary; this is not only useless, but may, after the child has nursed, provoke vomiting. If the cord was large, the ligature may slip, and slight bleeding occur. In such a case, a second ligature must be applied nearer to the navel.

Whether the infant is nursed by mother or wet-nurse, it should not be applied to the breast before twelve to twenty-four hours. [?] A few spoonsful of sugared water or milk and water will suffice until then. When the infant awakens, its napkin should be changed. Although many infants urinate and pass meconium shortly after birth, there are many who do not. In the latter instance nothing is called for; at the end of twelve hours or more, this matter regulates itself.

Every child should be weighed at birth. This is the only way to assure oneself of its gain. Usually, the infant loses a little in weight during the first three to four days, at the end of which period it begins to gain, and at the end of the week nearly all or a little more of the original weight has been regained. From this time forth a healthy and amply nourished infant, ought to gain ¾ to 1 ounce daily.

At the outset, the child should be applied to the breast every two hours, later every two and a half, or three. At night the intervals should be longer—every four hours, at seven, at eleven, at three or four in the morning, at eight or nine. The mother is thus able to sleep in the intervals, and the infant promptly accustoms itself to regular feeding. If the child obtains sufficient food, it goes to sleep at once at the end of the nursing, and awakens only at the expiration of two to three hours.

Every day the child should be bathed for five or six minutes, and without waiting for the fall of the cord, which occurs the earlier the stronger the child, from the third to the fifth day in infants at term, from the sixth to the eighth in premature infants. Until the cord separates, the dressing around it should be changed with care, and after separation a flannel or linen abdominal binder should be worn for a time. The infant should never go out until cicatrization is complete.

It is not until the end of the third or the fourth day that the passages contain no more meconium, that they become yellow, and acquire the normal color and consistency, that of beaten yolk of egg. At this period too, the infant may become yellow, the icterus of the new born. Generally of no import, this icterus, which varies in proportion to the weakness and bad nourishment of the infant, may, in exceptional cases, be grave. The same is true of ophthalmia. While this often yields to simple lotions, it may become purulent, and requires then energetic care, else the child may lose its sight. [The best treatment of purulent ophthalmia is instillations of a few drops of nitrate of silver solution (gr x to ℥ i) three to four times daily: frequent washing of the conjunctiva with a saturated solution of boracic acid; and cold over the eyes until all inflammatory, acute symptoms have disappeared. A convenient way of applying the cold is by means of little pledgets of cotton, which rest, until needed, on a piece of ice. If one eye is alone affected, the greatest care should be taken against infection of the second, and to prevent this, it is a good plan to seal the sound eye for a few days. The above method depends, for its success, on constant care night and day, and two nurses, or attendants, are therefore requisite. When we remember, however, that the infant's sight is at stake, the necessity of any amount of care and trouble is apparent. For the method of the prevention of ophthalmia neonatorum, see the section which refers to it.—Ed.]

Finally, towards the sixth or the seventh day, the child's breasts swell, and give exit to milk. Manipulation of the breasts should be avoided. The best treatment is flaxseed poultices. [Equable pressure, by means of a miniature bandage, such as has been described as applicable to the female breast, will answer every purpose, and prevent abscess.—Ed.] Sometimes a little abscess forms. We have seen two instances, and in children of the same mother.

Such is the care required by the infant during its first few life-days. For further particulars, the reader is referred to treatises on the diseases of children.

End of Volume I.

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